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An Improved Vacuum Pump and Compressor.

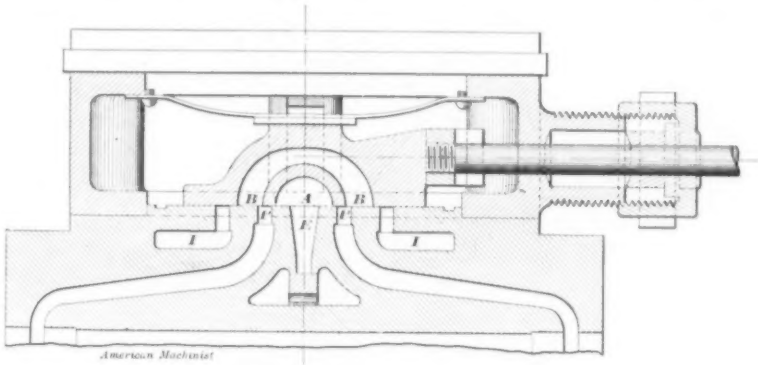
Messrs. Guild & Garrison, of Brooklyn, N. Y., are placing on the market a vacuum pump that is claimed to be much more efficient than the ordinary type.

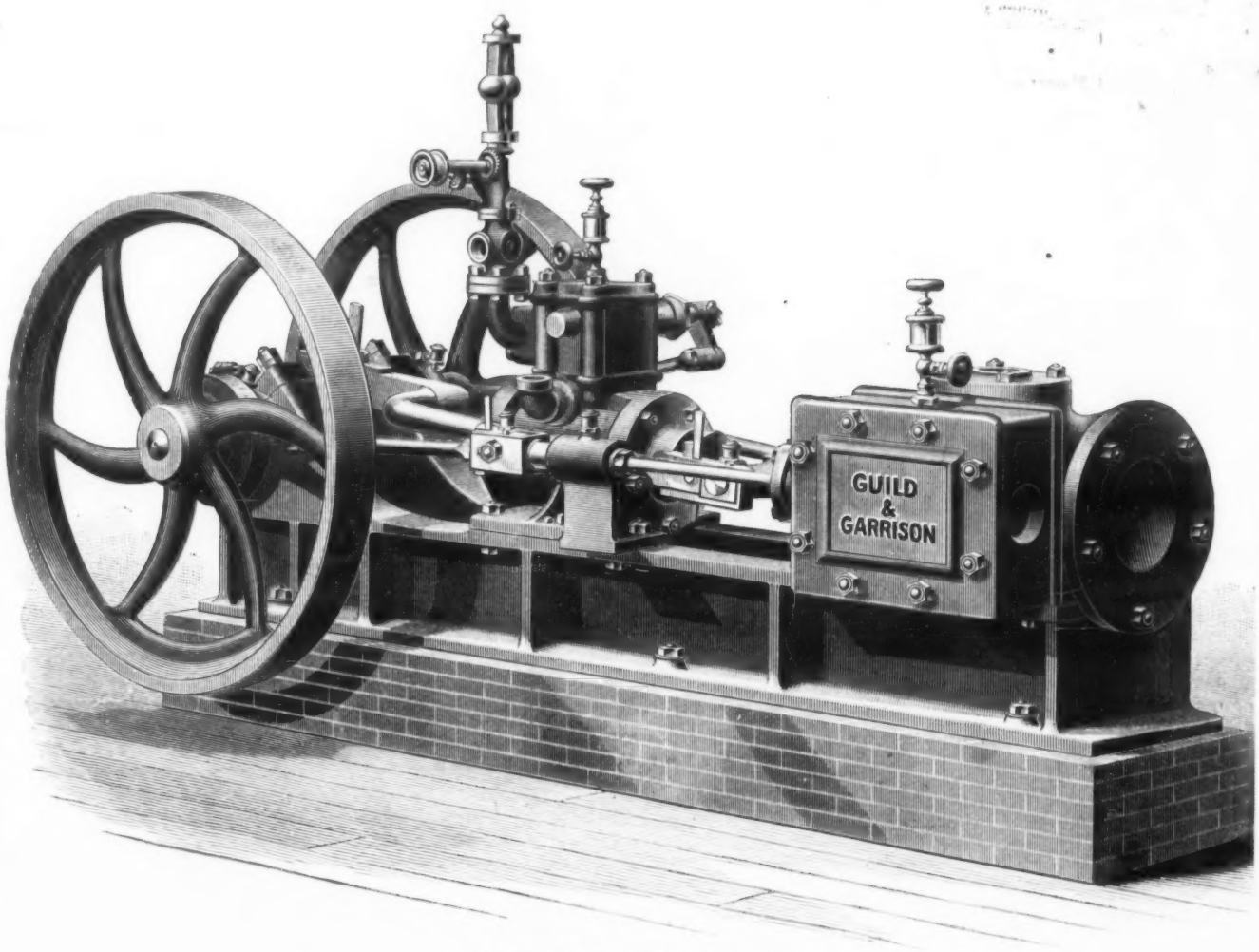
The general appearance is shown in the accompanying cut, and we give also a section of the valve chest which shows the detail of the particular improvement. The slide valve is so constructed, that, at the end of the stroke, the clearance space, after being closed to main delivery, is placed in communication with the suction end of the cylinder, relieving the cushion and increasing the supply on the suction side of piston.

The valve is shown in mid-position, the piston being near the end of its stroke, and the cushion air passing through *P*, *B*, enters the suction end of cylinder, to be discharged on the return stroke, through *A E*. *I I* are the main inlets which admit air to the opposite sides of piston through *B B*.

The relief of the cushion into the suction end raises the pressure there to a higher point than it would be otherwise, and so increases the delivery, not only by the amount so transferred but by the volume that would otherwise be occupied by the re-expanded air if trapped in the clearance spaces. We have examined a number of indicator cards taken from the air cylinder of this machine, and ranging from 29.4 inches of vacuum to 152 pounds pressure and they show excellent performance. These pumps are regularly built in sizes varying from 7 to 630 cubic feet per minute and special designs are prepared for any service desired.

The maximum pressure for which they are recommended is 60 pounds, though as stated above they have been tested considerably above this. The improvement in the valve as illustrated results in about 10 per cent. increased efficiency. The machines are, of course, made of various sizes and styles to suit conditions.





VACUUM PUMP AND COMPRESSOR.

Windmill Power for Electric Lighting.

BY E. SPENCER.

Considerable has been written of late on electric lighting by windmill power, very little of which is of any real value for the reason that but a small portion of what has been written was based on actual experience in that line. To people of prairie countries this is a question of great importance for the reasons that windmills have become so common, their efficiency has been increased to such an extent, that combined with their cheapness and wearing qualities they make an important source of motive power.

In the article by "Bell Crank," in your issue of November 29th, he, after explaining in a general way how electric lighting might be accomplished by wind power through the medium of accumulators, concludes by making a computation of the cost of lighting by wind *vs.* other motive power, unfavorable to the former. Now while "Bell Crank" may be very well informed on the subject he certainly speaks too lightly of a subject which has called forth the efforts of men who do not come under his class of "mechanics who have not made a special study of electrical machinery." Probably he will change his views of the subject after reading in the *Engineering Magazine* for December an article by Lieut. I. N. Lewis, "Generating Electricity by Wind Power," in which the gentleman shows very clearly that electric lighting can be done much cheaper by wind than by steam power. In his article he describes two plants in actual use. Those of Mr. Brush, at Cleveland, Ohio, and Mr. G. E. McQueston, at Marblehead Point, Mass. The former is evidently too elaborate to make a good example, but shows that wind is a cheaper form of motive power than steam for electric lighting. In the plant of Mr. McQueston we certainly have an example of what might be done by thousands of men who have the money and inclination, did they but know such a thing were possible.

As a comparison of the cost of operation of steam *vs.* wind power, Lieut. Lewis gives the following data furnished by owner of the plant, which was formerly operated by steam power:

Steam plants—75 lights—cost	$1,000
Depreciation - yearly cost	100
Interest	50
Attendance	75
Operating expenses	100
Total cost	$325
One lamp for six months	$4.33¼
Windmill plant—127 lights—original cost	1,800
Depreciation—year (5 per cent. on mill, 10 per cent. on apparatus)	130
Interest	90
Attendance	20
Operating expenses (oil, etc.)	10
Total cost	$250
One lamp for six months, say	$2

The plant was in operation but six months a year.

The question is one which will soon attract more attention than it is doing at present, and a discussion of the subject in these columns would probably result in a world of good. One thing is assured—that wind power *can* be used for electric lighting; whether it would be economical in both large and small [illegible] and in different parts of the country experience alone will show.

A Proposed New Standard Screw Thread.

It is a traditional belief in most machine shops that for certain purposes, notably traversing screws, threads must be square, and machine tool builders especially employ square-threaded screws very largely. Such screws do, however, possess certain well-known faults; they are somewhat more difficult to make than threads of other forms; it is not always easy to get the bearing surfaces as smooth as they should be, neither dies nor taps work as well as with other forms of threads, and finally the threads are relatively weaker at the base. For these and other reasons it is now proposed to abandon square threads almost if not entirely, and substitute for them a thread of the same hight, but having sides at the same angle to the axis of the screw as is used on standard worms, *i. e.*, 14½ degrees; making the included angle of the thread 29 degrees. Thus the only difference between this thread and those on a standard worm will be in the hight of the thread, which, as in square threads, will be one-half the pitch

for a working depth, $\frac{1}{10}$ inch being added to this for clearance at both top and bottom of each thread, thus making the screws $\frac{2}{10}$ inch smaller in diameter at bottom of thread than the bored hole in the nut, and the bottoms of the threads in the nuts $\frac{2}{10}$ inch larger in diameter than the top of the threads of the screw. This clearance it is proposed to make constant for all sizes of screws made according to this program.

The diagrams published herewith show (Fig. 1) the exact proportions and dimensions of the proposed threads; Fig. 2, a comparison of the square with the new thread; Fig. 3, a gauge for grinding tools, and Fig. 4, a gauge for setting them in the lathe.

The following figures will enable the proportions of a thread of any pitch to be readily computed: Width of point of tool for cutting tap or screw and of the top of tap threads = (.3707 ÷ the threads per inch) — .0052.

Width of screw or nut thread at top = .3707 ÷ number of threads per inch.

Diameter of tap = diameter of screw + .02 inch.

Diameter of tap or screw at root of threads = diameter of screw — (1 ÷ number of threads per inch + .02 inch).

Diameter to bore nut = diameter of screw — (1 ÷ number of threads per inch).

Depth of thread = 1 ÷ twice the number of threads per inch + .01.

TABLE OF PROPORTIONS.

No. Threads per in.	Depth of Thread.	Width at Top of Thread.	Width at Bottom of Thread.	Space at Top of Thread.	Thickness at Root of Thread.
1	.5100	.3707	.3655	.6293	.6345
2	.2600	.1854	.1802	.3147	.3199
3	.1767	.1235	.1183	.2098	.2150
4	.1350	.0927	.0875	.1573	.1625
5	.1100	.0741	.0689	.1259	.1311
6	.0933	.0618	.0566	.1049	.1101
7	.0814	.0529	.0478	.0899	.0951
8	.0725	.0463	.0411	.0787	.0839
9	.0655	.0413	.0361	.0699	.0751
10	.0600	.0371	.0319	.0629	.0681

The figures on the gauge (Fig. 3) indicate number of threads per inch, and we think an inspection of it makes it apparent that there should have been at least one pitch between 1 and 2, as there is quite a gap there into which machine tool builders will be sure to fall in order to get a suitable thread in some cases. But on stating this view to Mr. A. W. Handy, who has been the prime mover in this proposed reform, he thought this or any other gap which might occur in the gauge could easily be filled in

1½ threads per inch, where the width of the tool would be (.3707 ÷ 1.5) — .0052 = .2418 inch, or practically .242 inch.

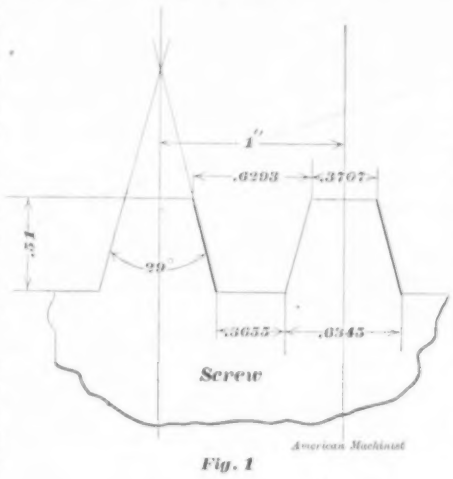


Fig. 1

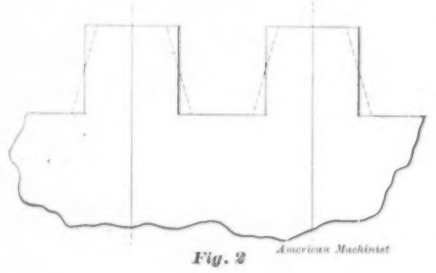


Fig. 2

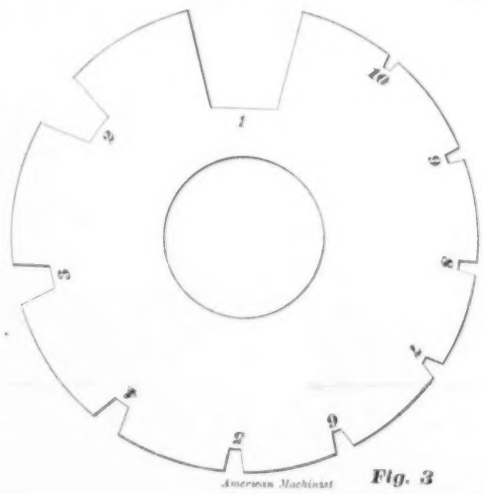


Fig. 3

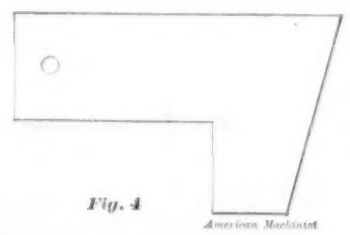


Fig. 4

A NEW SCREW THREAD.

It is intended that this thread shall not only replace square threads, but also the numerous forms of bastard threads now used, no two of which agree in any particular, and it will be apparent that it has many practical advantages; as to these, and its disadvantages also, our columns are open for discussion. Mr. Powell, of the Powell Planer Co., has become somewhat interested in the matter, and made the computations. The Brown & Sharpe Mfg. Co. were sufficiently interested to make a set of the gauges, and the addition of clearance as given was their proposition.

Mr. Handy has named the new thread the "Acme Standard."

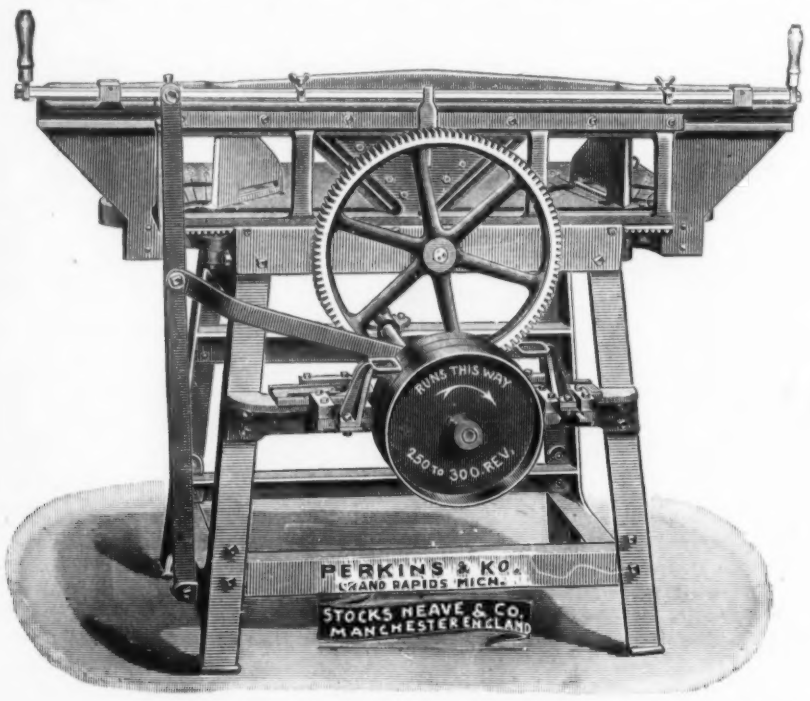
Belted Universal Trimmer.

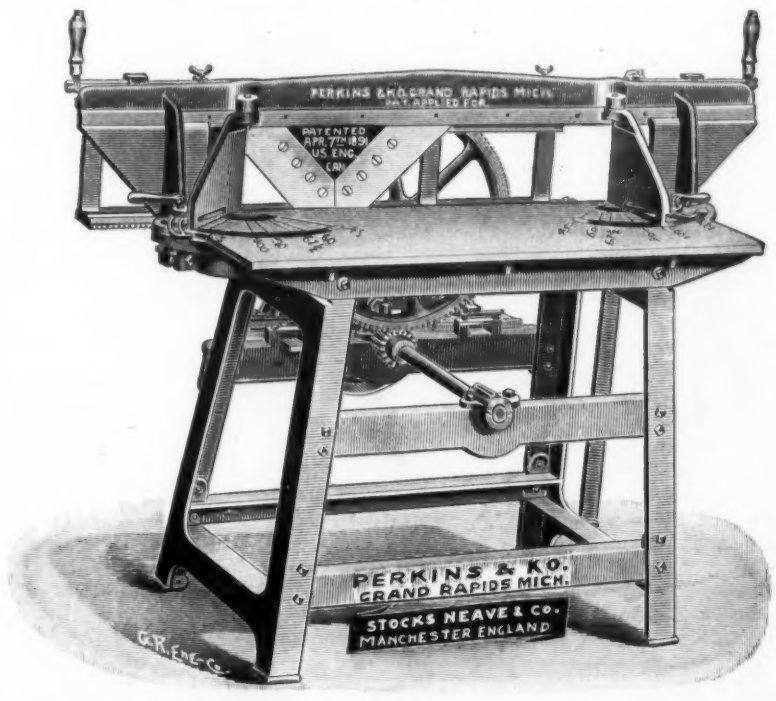
Universal trimmers have, since we first introduced them to our readers, become a well recognized and standard part of modern pattern shop equipment, and we present herewith a front and a rear view of such a machine which is arranged to be belted and driven by power.

The carriage which carries the knife has a rack on the under side which is driven by a pinion that is on the same shaft with the spur gear shown in the rear view of the machine. This gear is in turn driven by a pinion, the motion of which is reversed by what is essentially the open and crossed belt device commonly used on machinists' planers, and reversed by tappets adjustable upon a horizontal rod and struck by the carriage. The arrangement is such, however, that instead of making repeated strokes the carriage stops at the end of the return stroke; as, of course, it should in a machine of this kind. It is set in motion from either end of the machine by the handles seen at the ends of the tappet bar.

The knife has a travel of 32 inches with long bearing surface and adjustable gibs for taking up wear. At each end of the knife travel there is an adjustable gauge which can be set at any angle to the line of knife travel from 45 degrees acute to 45 degrees obtuse, thus permitting any desired angle to be trimmed from 45 degrees to 135 degrees. Adjustable stops are located on the outside of the limit of travel of the gauges; these are seated in grooves in the main bed, and are readily shifted so as to gauge the angle of the wing to the knife, and thereby the angle of the stock to be cut. This permits the double mitering of large stock, as the wing may be thrown back out of the way.

The general features and advantages of such machines for patternmakers' use are sufficiently well understood and, of course,





BELT DRIVEN UNIVERSAL TRIMMER.

any case, so far as making the necessary tools were concerned, by simply using the regular worm thread gauge, which, as already stated, is the same angle, but grinding off the end of the tool in accordance with the proportions given. An instance of this would be in the case of a screw having

power-driving will increase their efficiency, especially for heavy work. The machine is made in only one size, and will trim 30 inches wide; will double-miter 19 inches; occupies a floor space 79 inches by 34 inches and weighs 700 pounds. It is made by Perkins & Co., Grand Rapids, Mich.

Machine Shop Milling Practice.

BY HORACE L. ARNOLD.

Fig. 83 (page 3) is a construction of the Ingersoll 15-inch open side milling machine, of which general views and description were given in the AMERICAN MACHINIST, December 20, 1894.

These clear drawings are sufficiently in detail to be readily understood when examined in connection with the full views given in the previous article. This sheet of drawing is valuable as an example of elegant simplicity of construction for obtaining the great variety of motions needed for the spindle, feed, knock-off and lubricator pump, all conveniently arranged and direct in action. The table feed thrust is taken by hardened and ground steel washers; the feed screw is worm driven, with a drop worm and knock-off at one end, and spur geared for a quick motion in either direction, governed by a reversing hand-lever in front of the machine for quick moving of the table; except that the quickest feed cannot be had with the slowest spindle speed, the movements are ideal and show careful study. In the Ingersoll 24-inch and 36-inch machines an expedient is adopted which gives any feed with any spindle speed. In this 15-inch machine there are four changes of feed for each of the changes of cutter spindle speed; these four feed changes, however, depend directly on the spindle speed for the feed rate, which is not the case in the larger sizes mentioned.

The feature of power driven quick adjustments is very fully carried out in the Ingersoll 24-inch by 24-inch milling machine, shown in Figs. 84 and 85. This machine has a table 21 inches wide, 72 inches between pockets, 6¼ inches deep, and a quick power adjustment of 30 feet per minute in either direction, with a spiral (worm and worm gear) driven feed motion with a friction disk variable drive from $\frac{3}{16}$ inch to 5 inches per minute, with automatic knock-off at any point of table travel. The spindle is 4½ inches diameter, 25 inches bearing, back geared 20 to 1, with eight changes of speed and 12 inches horizontal (endwise) adjustment. The spindle driving spur gear is 24 p. d., 3 d. p. The cutter arbor, furnished with machine, is 2½ inches diameter, with outboard bearing 5½ inches long. Cutters 15 inches diameter and 24 inches long can be used. Housing (or uprights) double web, 7 inches wide. The cross rail is 14⅜ inches wide, with a hand vertical adjustment reading to thousandths. The driving cone has four steps 14 inches to 20 inches diameter for 4-inch double belt. Two countershafts furnished with each machine; speed of driving counter 266 revolutions, and quick return countershaft 225 revolutions per minute. Pump and water tank with each machine. A vertical spindle is furnished to order at a

small cost. This vertical spindle head slides on the cross rail, and gives an extremely good vertical spindle support, quite sufficient for any size of end mill which need be used. In the illustrations of the 36-inch machine this vertical spindle will be shown. The construction is such as to make the machine really and readily convertible from a horizontal spindle machine to a vertical spindle miller, with a very large and strongly driven spindle, so that the vertical spindle is not a mere Jack-at-a-pinch makeshift, but a thoroughly efficient member fully equal to the employment of the entire driving power of the machine, and its utility cannot be overestimated.

In adopting the planer form for the groundwork of this 24-inch milling machine, Mr. Ingersoll has followed well-established English practice, which no other American maker has yet adopted in a regular line of work. Mr. Ingersoll has added one extremely valuable special feature to the planer design by tipping the front face of the cross rail over forward at the top, thus securing two advantages which the common vertical faced rail lacked. A triangular section of rail is thus obtained which ensures stiffness in lines of horizontal strain, and increases resistance to bending in the line of lifting strains, and at the same time improves the support of the vertical spindle head as well as that of the horizontal spindle and its outboard bearing. This triangular cross rail is one of the first features of the machine to strike the eye of the designer, and the propriety of the innovation is at once apparent. The thin flat cross rail is objectionably weak fore and aft; and the uniform thickening of the cross rail to make up a stiff width of cross rail is still more objectionable, as every increase of the spindle distance in front of the uprights is a menace to the vertical stability of the spindle, and vertical stability is the one imperative demand of milling machine designs where a 24-inch width of cut is to be supported; it was bad to have a thin rail, and still worse to have a thick rail, but by the happy thought of a rail thick on top and thin on the bottom, Mr. Ingersoll has been able to secure added stiffness of the cross rail to resist horizontal strains, added resistance to lifting strain, by increase of the tensile member of his beam, and at the same time has advanced the spindle location very little if at all in front of the uprights.

On the left-hand side of the machine, Fig. 85, the spindle drive and the variable feed disk are very clearly shown; the right-hand side, Fig. 84, shows the quick table adjustment operated either by power or by hand; the large vertical friction disk with three horizontal handles is fast on the first shaft of the table-feed drive; the large worm gear just behind the disk is loose on the disk shaft, to which the worm gear is friction connected by a movement of the hand wheel in the middle of the friction disk. The hand wheel in the rear of the knock-off lever gives the traverse of the friction wheel across the friction-feed disk shown in Fig. 85. All of this fast and slow table action is extremely convenient for the workman, and the worm reduction through the large worm gear behind the friction disk, Fig. 84, gives a very strong drive for the first feed shaft. I have not seen the 24-inch Ingersoll machine at work. I have seen the 36-inch machine at work in the Watts-Campbell shops, Newark, N. J., and expect to fully test its capacity there. From the Ingersoll shops I have the following illustrations and specifications of cuts.

Countershaft Speeds 108 and 216 R. p. m.
Cone Speeds 84, 108, 139, 168, 216 and 278 R. p. m.
Cutter Speeds 15, 19, 25, 30, 38 and 50 R. p. m.
Power of Machine 10,125 inch lbs.
Pull on 4½" Cutter 4,500 lbs.

FEEDS.

Per rev. of Cutter .015", .027", .045", and .079".
Per min. .225" to 3.95".

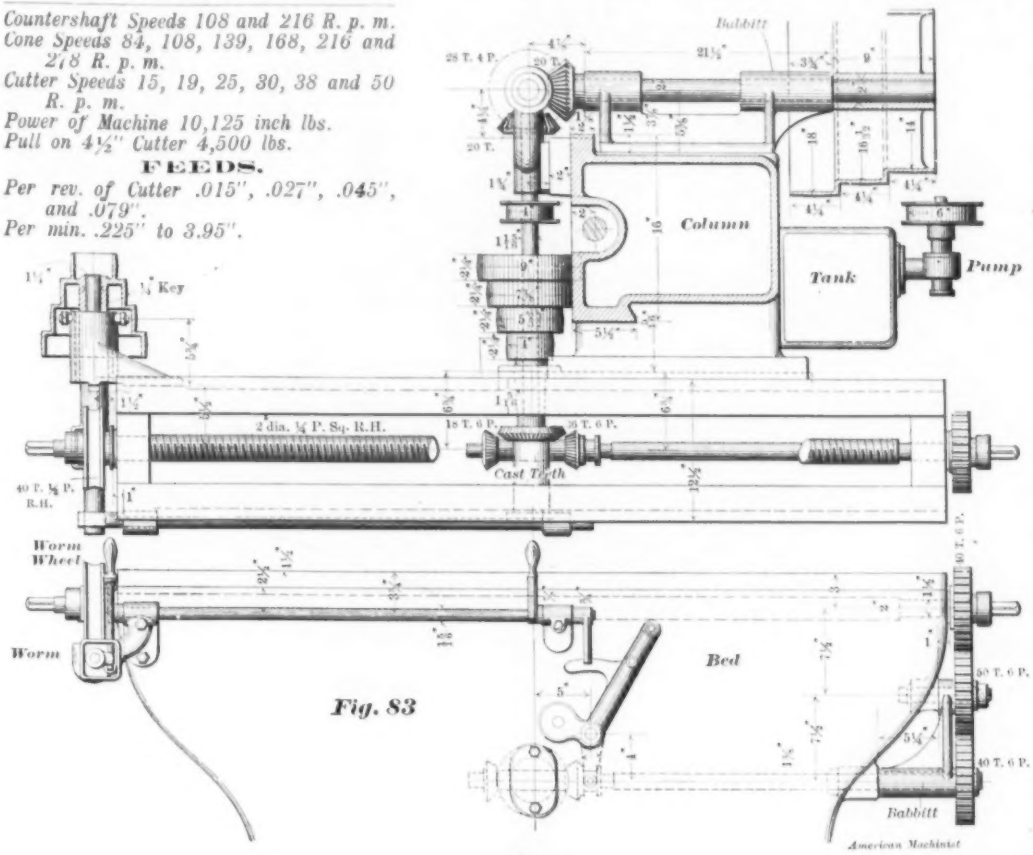


Fig. 83

As will be noted, all of these cuts were made on one of the earlier patterns of this machine (Cleveland built) with a plain cross rail, and with right and left rail elevation screws. This vicious elevating device has been corrected in later machines, in which, as shown by Figs. 84, 85, the elevating screws revolve in the same direction, and are hence either both right or both left hand. It is now well understood that a right-hand screw and a left-hand screw cannot readily be made to exactly match each other in lift for equal turns through their entire length; I know of planers by makers of the first repute which never have their cross rails moved at all, because any movement of the cross rail throws it out of parallelism with the surface of the table, simply because the cross rail is elevated by a right-hand screw at one end, and by a left-hand screw at the other end. This fault does not exist in the present Ingersoll 24-inch machine, although it is shown in all three of the work examples, *not* made on a 24-inch machine, but on a 22-inch machine, the forerunner of the 24-inch, and, I believe, not now made by the Ingersoll Company, the 24-inch having taken its place. Fig 86 "shows 22-inch machine," as Mr. Ingersoll writes, "with 96-inch table, slabbing our standard 22' x60" table standard patent cutter, six rows of 45 teeth each ⅝ inch face, cutter 4½ inches diameter."

Revolutions per minute 33.

Feed per minute 4 inches.

Surface speed of cutter 38 feet.

Feed per tooth 0 02+ inch.

Fig. 87, second operation on same table, milling three slots $\frac{11}{16}$ inch wide by 1½ inches deep, full length of table; inserted mill teeth $\frac{5}{16}$"x$\frac{9}{32}$" in cast-iron disk, no fastening, simply driven. Diameter of cutters 6⅜ inches, 14 teeth, 25 revolutions, feed 3 inches per minute. It will be observed that the combined section of these cuts is $3\frac{9}{100}$ square inches, which is certainly not light work.

Surface speed of cutter 41 feet.

Feed per tooth 0.009— inch.

Fig. 88 shows same machine cutting teeth in 9 d. p. rack stock, to be cut into narrow face racks 15½ inches long. The stock is first squared to 15½"x15½"x$\frac{3}{4}$", then 39 teeth are milled with 13 cutters in a gang, spaced three teeth center to center, and moved twice, each movement = pitch of rack, using micrometer dial on the spindle-adjusting screw. The toothed stock is next turned at right angles and cut into 18 separate racks. It will be observed that this method saves no less than 65 cuts over making the racks of individual pieces at the start, if the 18 racks are separated with a gang of saws at one cut, even if the four sides of the racks have but one flat cut over each.

Cutters 3½ diameter, 14 t., 33 revolutions, feed 2 inches per minute.

Surface speed of mills 30½ feet.

Cut per tooth 0.0043+ inch.

This method of making racks would seem to compare very favorably with detailed practice, previously given in these papers.

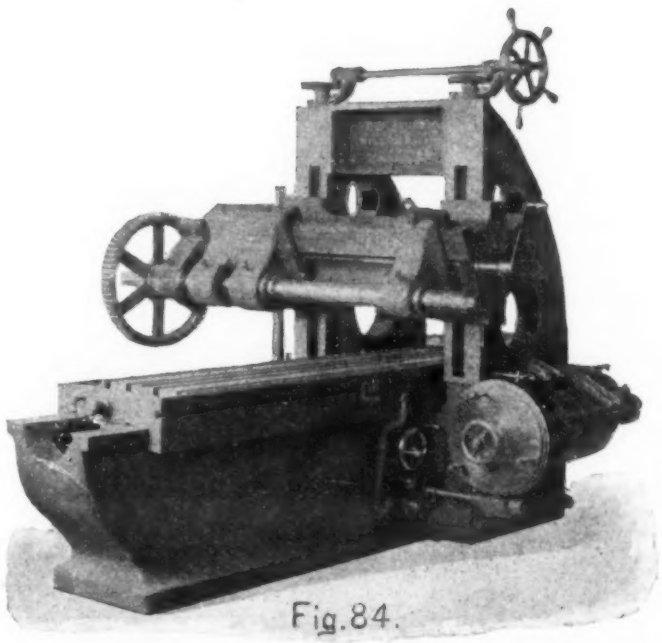


Fig. 84.

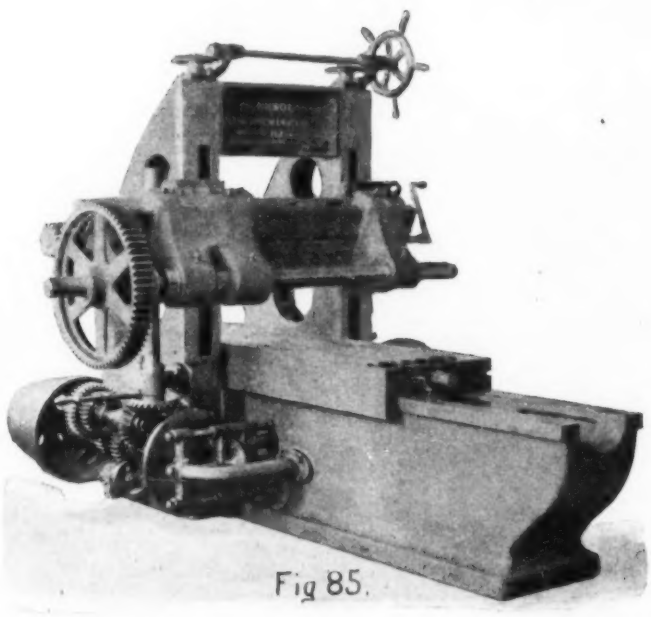


Fig 85.

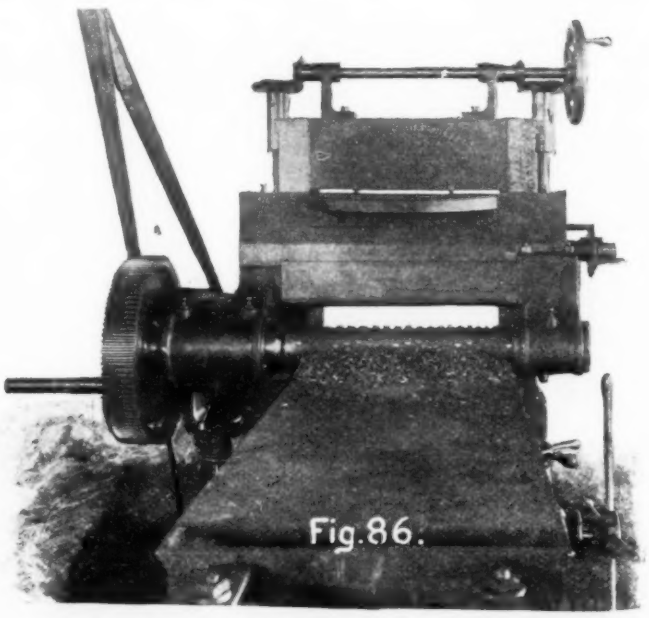


Fig. 86.

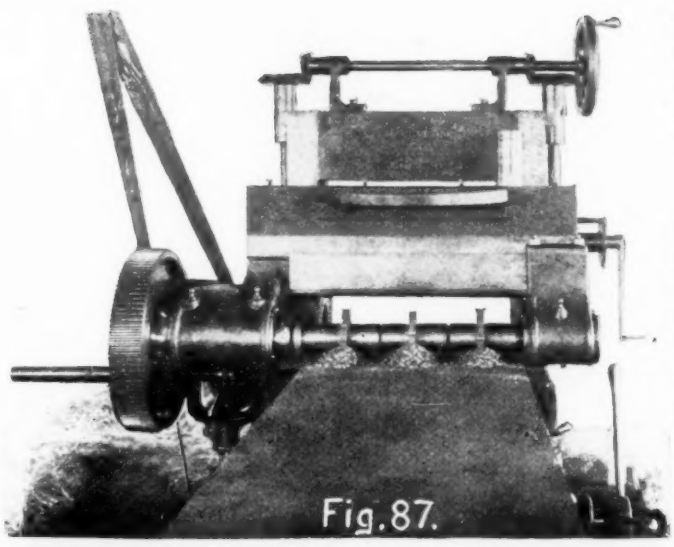


Fig. 87.

I may here say that recent work at Brown & Sharpe's seems to indicate that the *per tooth* feed is not the dominating factor, but the *per revolution* feed determines the work done and capacity of the tools. As long since noted in these papers, the per tooth *cut* may be anything, wholly irrespective of the per tooth *feed*, because only a few of the teeth cut in one revolution; hence the "revolution mark," and hence the action of the mill approaches that of a single tooth cutter, and the advance per revolution, rather than the advance per tooth, is the defining measure.

Fly-wheel Arms.

BY CHARLES M. JONES.

In a paper on the "Moment of Inertia," that has recently attracted attention, the author—who seems to have radical views regarding the application of the term—lays down the principle that the arms of a fly-wheel are equally strained at hub and rim by the bending forces called into play during retardation and acceleration, and concludes therefore that such arms should be of uniform section throughout. Unfortunately, the elaborate calculation on which this is founded starts from a false assumption, and manufacturers who are considering the advisability of scrapping their patterns on the strength of the demonstration, will do well to go slowly in the matter.

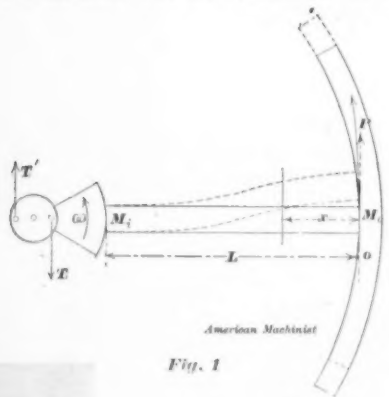


Fig. 1

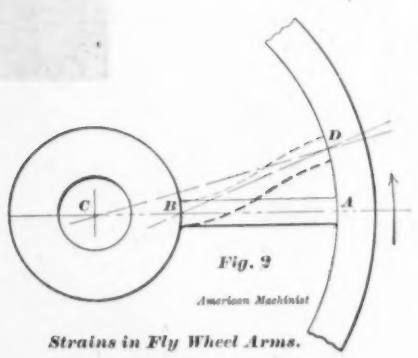


Fig. 2

Strains in Fly Wheel Arms.

FLY-WHEEL ARMS.

In Fig. 1, the point M_0 is supposed strained to the dotted position, the cross-section being assumed to remain parallel to that at M_1, and no calculation is necessary to show that in this case the stress in a uniform arm would be equal at the ends.

But actually the section M_0 swings through the same angle relatively to its initial position that the *point* M_0 does in relation to *its* line of reference, and the stress at the rim is eased thereby.

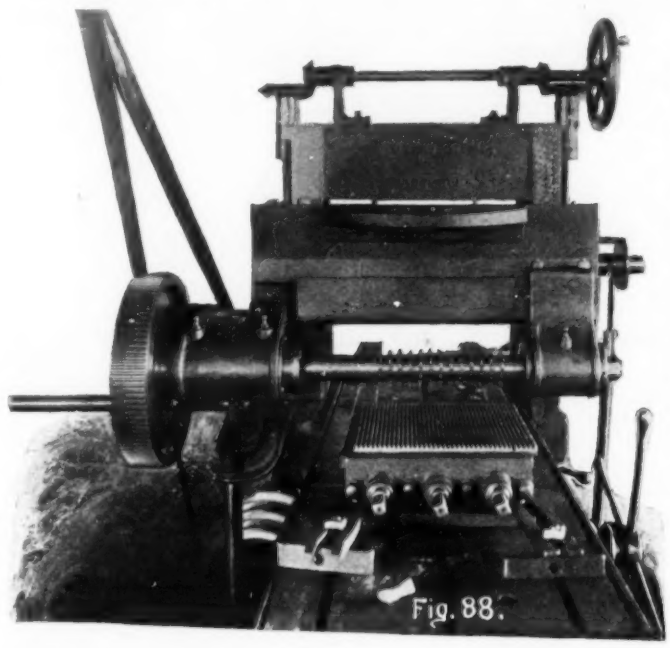
In Fig. 2, let the point A be strained to D by the rim inertia; then since such displacement is very small up to the breaking point of any actual wheel, the sines of the angles $A\,B\,D$ and $C\,D\,B$ are as the arcs, and within the *limit* this is strictly so.

Also within the limit the bending strains at B and D are proportional to the angles between normals to the sections of arm, and line of displacement $B\,D$.

Call the arc $A\,D = a$, then the small arc at hub subtending $C\,D\,B$ will be $\frac{a\,r}{R}$, r and R being radii of hub and rim respectively, and therefore the relative angles are:

$$\frac{C\,D\,B}{A\,B\,D} = \frac{\sin.^{-1}\frac{a\,r}{R(R-r)}}{\sin.^{-1}\frac{a}{R-r}} = \frac{\frac{a\,r}{R(R-r)}}{\frac{a}{R-r}}$$

$= \frac{r}{R}$, and as the strain is proportional to such angles $\frac{S'}{S} = \frac{r}{R}$, that is, the bending strain at rim is to strain at hub as the radius of hub is to radius of rim. If the hub is half the diameter of inner portion of rim, the rim strain will be *half* that at hub.



This shows that for most practical purposes the arms can be assumed as fixed at B and loaded at A, and after the B section is found A is readily determined by the above relation.

Any giving of the rim itself eases the strain at A.

Drop Hammer Mechanism.

Not long since we published an illustrated description of an improved drop hammer, made by the Miner & Peck Mfg. Co., New Haven, Conn. This hammer, as we stated at the time, was so arranged that the movable friction roll was moved to and from the board in a straight line, and rapidly, so as to reduce useless rubbing and friction between rollers and board to a minimum.

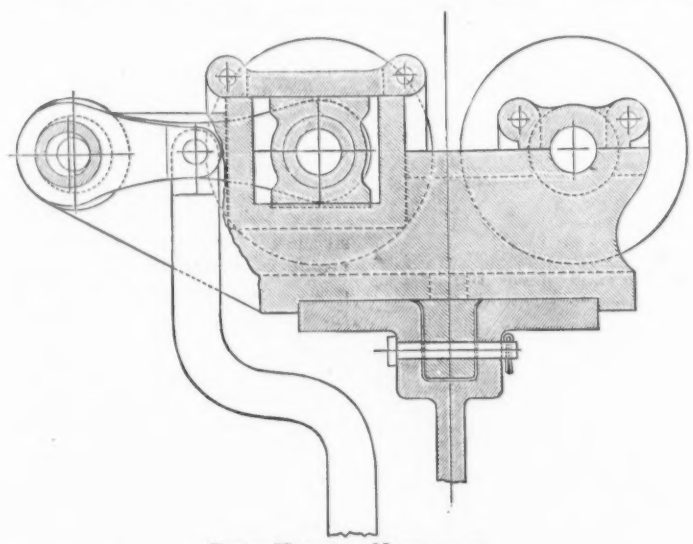
The sectional view of the mechanism which we present herewith shows the arrangement for accomplishing this.

The shell to which knuckle joint arms are fastened is held in position by an eccentric shaft. This shaft is revolved by an arm on the end of same, thus moving the roll, through medium of knuckle joints, out and in, varying the distance between rolls to compensate for wear of board.

The action of knuckle joint mechanism is also shown, and needs no explanation.

It will be observed that there is a bushing in the front box around the shaft. This bushing projects toward the roll and passes through the knuckle joint; by this means there will be but very little wear on the knuckle joint, and should the interior of bushing on shaft wear, a new bushing can be readily inserted.

The general description of the hammer of which this mechanism forms a part will be found in our issue of October 4, 1894.



DROP HAMMER MECHANISM.

Square Base Jordan Planer Chuck.

We present herewith engravings of a square base planer chuck, made by G. W. Jordan, Worcester, Mass.

The first engraving shows it as made in sizes from 6 inches to 12 inches, and the second one in the sizes from 15 inches to 30 inches inclusive, the latter having through the center of the bed a T-slot, in which a bolt is placed that passes through the center of the jaw; an arrangement which is not necessary for the smaller sizes.

Referring to the second engraving, the movable jaw I is held down by bolts A and C, screwed tight in gibs E, which run in the grooves F in the side of the bed. In addition to the bolt B already mentioned, the holding block J is held by the steel bar G, which engages in the slots H, and which can be raised out of same. The holding block J and the jaw I can be moved instantly from the least to the greatest capacity, and there locked. The final adjustment is made with the set screws in holding block J. The jaw I cannot tip or spring back, because the tongue on the holding bar J lifts on the back of jaw I, and tends to throw it forward. The jaw I has a strip of tool steel on its back edge for set screws to go against. The set screws are of tool steel and are hardened.

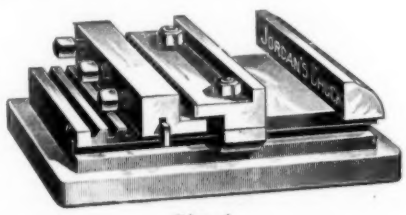


Fig. 1.

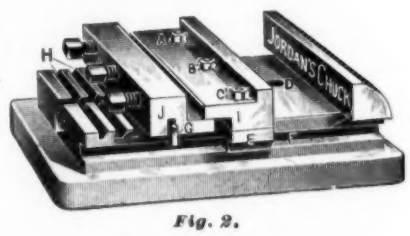


Fig. 2.

PLANER CHUCKS.

We have previously announced that it was thought that the spring meeting of the American Society of Mechanical Engineers would take place the first week in July, at Detroit. It is now expected that it will take place late in June instead.

A Paradox in Hydraulics—The Impact Pump.

BY GUS. C. HENNING, M. E.

Every text-book, trade catalog or hand-book on pumps tells us that the delivery of reciprocating pumps is equal to the displacement of the plungers in a given time multiplied by a certain coefficient of slip, loss, leakage or inertia, and a most important element is entirely neglected, as by examining books on physics it will be found that nothing is said about the fact that the rule is correct *only when the velocity of the mechanism is very low*. That this is a fact is demonstrated by the operations of a single-acting pump, the delivery of which is about three (3) times that given by the common formula.

This statement, which will be demonstrated experimentally and finally mathematically, and a little patience will convince the unbelievers that they had better remodel their elementary knowledge and formulæ of pumps. To mathematicians and engineers it will show that the common formulæ are based on partial facts, and that they are correct between small limits only. Furthermore, while the mechanical efficiency of ordinary reciprocating pumps never rises above 58 per cent. in the most economical cases, centrifugal pumps under favorable conditions showing 68 per cent., this impact pump, which is nothing but a rapidly-moving single-acting machine, has a delivery as high as 145 per cent. of its space displacement, and more by actual tests.

Moreover this impact pump is operated without an air chamber, and a foot valve is only used in starting when the suction lift is greater than four (4) feet; it starts instantly without wetting the single valve in the plunger, or priming; in fact, it works under just those conditions which make other pumps inoperative. The radical difference between this and other pumps is this, that the direction of motion of the column of water is invariable, and that the rate of motion remains nearly constant; hence the inertia of the column of water above and below the plunger acts constantly to keep the water in motion, without interference or obstruction of plunger or valves. The time between successive strokes of the pump is so very small that gravity has no appreciable effect on the moving column of water, which is, furthermore, kept in motion by a very small quantity of air, which is admitted below the plunger in a constant stream, its quantity depending on the speed of the pump. This air after passing through the valve in the plunger is compressed by the latter, expanding during the downward stroke, thereby also impelling the water upward in the delivery pipe. The latter must be smooth with easy bends instead of elbows, and avoiding all corners or spaces which might trap air.

The pump tested is shown in Fig. 3 (page 5). P the piston carrying a rubber valve V of the "loculicidal type," *i. e.*, a cone split in three planes, connected to a ring at its base, moves in an enlargement of the suction pipe C, through a stuffing box b, and is driven by a crank and connecting rod on shaft F, which carries a driving pulley and fly-wheel. The chamber C contracts by an easy curve D into the delivery pipe. Below the piston will be noticed a small pet cock or air valve a, by adjustment of which the proper amount of air is admitted. The valve V is in a cage, and as the piston descends it opens in three parts, closing instantly when at lower end of stroke, by its own weight and elasticity of the material, where the three parts are connected to the base ring. The fact that the C of G of each part of this conical valve is within the line at which it is attached to its base, causes it to close by its inertia as well, and the action is practically instantaneous. The diameter of piston is 3.156 inches, with the length of stroke of 2.362 inches; the number of revolutions varied from 278 to 417, while the hight of orifice of discharge was about 50 feet in one set of experiments, and 100 feet in the other.

The number of revolutions, elevation, de-

livery, as well as work done and efficiency are given in the annexed table, and from this it will be seen that the capacity of this pump is more than double that due to piston displacement, while the efficiency rises to 94½ per cent. under favorable conditions of high lift, while under the lesser lift 83½ per cent. is reached.

The work transmitted to pump, as given under Q in Table I., was measured by a dynamometer, the volume of water delivered per minute was measured, and is given under P^1; the hight of orifice of discharge pipe above water level is given under h.

Revolutions.	Work transmitted.		Actual delivery.	Actual work done.	Efficiency.	Theoretical piston displacement.	85 per cent. of displacement.
n	Q	h feet.	P^1 gallons.	Q^1	$\frac{Q^1}{Q}$ per cent.	Gallons.	
295	27,510	49.85	46.70	20,950	76.1	23.5	20 0
302	29,047	49.85	54.78	22,820	78 5	24 1	20 5
349	32,547	49 85	55.25	25,324	77 8	27.9	23.7
352	30 810	49 85	62 38	25,985	84 3	28.1	23.9
360	31,590	49.85	63 32	26,380	83.5	28.8	24.5
417	37,536	49.85	75.19	31,325	83.5	33.3	28.3
278	41,442	101.7	46.07	39,146	94.5	22 2	18 9
289	44,828	101.7	47.34	40.225	89.7	23 1	19.6
299	46,434	101.7	51.45	43,721	94.1	23 9	20.3
308	48,170	101.7	53.02	45.068	93 5	24 6	20 9
319	47.953	101.7	51.80	43,577	90 9	25.5	21.7
321	48,388	101 7	53.02	45,068	93.1	25 6	21.8

The last column gives the theoretical piston displacement of the pump due to number of strokes given; actual piston displacement for one stroke being 18.46 cubic inches. As the actual delivery of small pumps is less than the piston displacement on account of "slip," being, at most, 85 per cent. of the theoretical value; the last column shows probable delivery of so small a pump. From these last two columns it will be seen that the actual delivery of this pump is more than double the piston displacement at all speeds given, or that of any other pump, and it will also be seen that this delivery is obtained with a higher efficiency than found in any other. It will also be noted that the efficiency increases with the hight at which the water is discharged, and this fact makes the pump particularly valuable as a fire pump.

Now let us examine the mathematical principles on which the action of this pump can be explained.

Let us suppose a column of liquid to be acted upon by a vertical force applied to its base.

Let V = the velocity acquired by this column at the instant when this force ceases to act. After a time $= t$ this velocity, by reason of retardation of gravity, would become

(1) $v = V - g\,t$; supposing other forces also acting the formula would be in general:

(2) $v' = V - f\,t$, the retardation of all active forces being represented by f.

Suppose the upward force to be produced by a piston driven by a crank of stroke $= d$, making n revolutions per second, the velocity of the piston after any given time t (less than ½ revolution) will be

(3) $v' = \pi\ d\ n \cos.\ \alpha$, in which α = the angle which the crank makes at instant t with a horizontal through center or its axis.

Since the angular velocity of the crank is uniform (4) $\alpha = n$ 360 degrees t.

Since the variations of the velocity v' will be the same for each revolution, one may express the time in fractions of the circumference of a circle, and need not consider more than one revolution.

n, being the number of revolutions per second, time of one revolution $= \frac{1}{n}$; calling Θ the fraction of one revolution corresponding to time t, we have

$t = \frac{\Theta}{n}$; equation (4) then becomes

(5) $\alpha = n\ 360 \times \frac{\Theta}{n}\ 360\ \Theta$ and (3) becomes

(6) $v' = \pi\ d\ n$ cos. 360 degrees Θ. This velocity v' will be maximum and positive for $\Theta = 0$ or $\Theta = 1$, and

(7) $v = v' = \pi\ d\ n \cos\ \alpha = \pi\ d\ n$.

After a time Θ, the velocity of the column has become

(8) $v = \pi\ d\ n - f\,\Theta$,

(or when $f = g$ = the acceleration due to gravity,

(8_1) $\pi\ d\ n - g\ \Theta$) and that of the piston

(9) $v' = \pi\ d\ n \cos.\ (360\ \Theta)$.

If (8) diminishes more slowly than (9) the valve will be lifted and a certain amount of fluid will pass through it. The valve will close whenever

(10) $\pi\ d\ n \cos.\ (360^\circ\ \Theta) = \pi\ d\ n - f\,\frac{\Theta}{n}$.

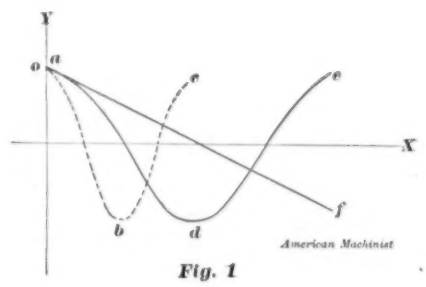


Fig. 1

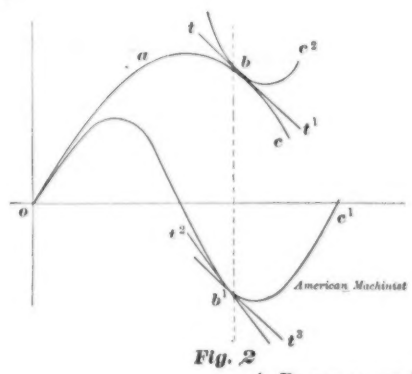


Fig. 2

A PARADOX IN HYDRAULICS.

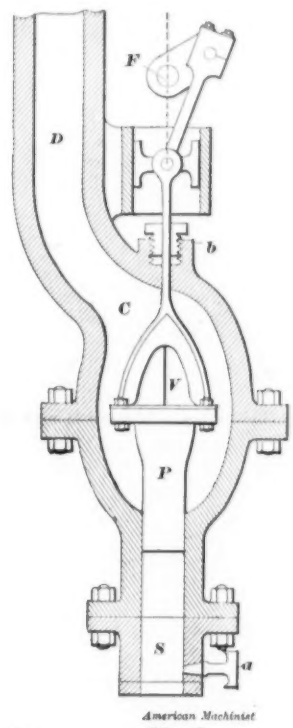


Fig. 3

By developing equations 8 and 9 we obtain Fig. 1. It will be readily seen that the valve will not open at the initial point of motion, but at the instant when the line $y_1 = \pi\ d\ n - f\,\frac{\Theta}{n}$, or a—f becomes tangent to the sinusoid a—d—e; should this point coincide with the point of inflexion there will be no admission of water; *i. e.*, that for $\pi\ d\ n = f\,\frac{\Theta}{n}$ and $\Theta = \frac{1}{4}$ the column of water will merely oscillate, rise and fall with the plunger.

Hence two of the three variables d, n and f being known the value of the third necessary to cause a flow of water through the valve can be readily calculated. It is assumed, of course, that the valve is not held upon its seat. Now let us suppose $\pi\ d\ n > \frac{f}{4\,n}$, let us consider the curve (8) $y = \pi\ d\ n$ cos. (360 degrees Θ), and the right line (9) $y_1 = \pi\ d\ n - f\,\frac{\Theta}{n} + e$; e being determined by the condition that (9) be tangent to (8).

The velocity of admission of water will be measured at every instant by the difference between the ordinates of the straight line $\overline{a\,f}$ and the curve $o\ a\ d\ e$, and the quantity of water passing the valve will be represented by the area included between the line $\overline{a\,f}$ and the curve $o\ a\ d\ e$.

Now suppose $\pi\ d\ n$ constant and let us make d and n variable, the position of the line $a\ f$ will remain practically the same, while the velocities of delivery will increase or decrease as d increases or decreases, and consequently at n increases or decreases.

Also, as the maximum velocity of piston remains constant, the delivery of the pump can be made to vary, but this is not the fact of greatest importance of this law. The right line $\overline{a\,f}$ intersects the curve $o\ a\ d\ e$ either above or below the axis of X.

When this intersection lies above axis of X it will be evident that the column of water receives a new impulse before having taken a negative or downward velocity or motion; in the contrary case the column has fallen somewhat, but in the first case the valve also closes more suddenly than in the second, and the new impact is instantaneous.

Experience alone can demonstrate at which point of intersection the delivery of the pump will be a maximum.

The motion of the liquid column is a double one; the first due to the impact of the ascending piston with valve closed, and the second that due to this impact during the period of descent of the piston. The two parts of the movement of the liquid are represented by the integrals of equations. (8) and (9) and are

(11) $Y = \pi\ d\ n$ sin. (n 360 degrees t) and

(12) $Y' = \pi\ d\ n\ t - \frac{1}{2}\,f\,t^2 + C\ t$.

Equation (12) gives curve $o\ a\ b\ c$, Fig. 2, while (11) gives $o\ b'\ c'$; and the difference between their ordinates at any abscissa gives the difference between velocities at that instant of stroke. The parabola $o\ a\ b\ c$ represents the decreasing velocities of the column of water due to the first impact of the piston, which are augmented by the second impact where the tangents to $o\ a\ c$ and $o\ b'\ c'$ are parallel, as $t^2 - t^3$ and $t - t'$. The new velocity would be represented by curve $b\ c^2$, a curve similar and parallel to $b'\ c'$.

This analysis would therefore be very simple, if experiment had not shown the necessity of introducing a certain amount of air under the piston at each stroke, for the purpose of making the moving liquid somewhat elastic. But this effect is not the only one; this quantity of air has among others a disturbing effect which slightly modifies the previous theoretical conclusions.

The acceleration f takes account of all forces acting upon the liquid column, and becomes $= g$ when gravity alone is considered. When discharging into a reservoir under constant pressure this pressure has a constant effect, say, $= p$, and its acceleration $= f = \frac{P + p}{M}$, in which P = weight and M = mass.

If the reservoir is under suction, p becomes negative and f will be less than g. In the first case the delivery is decreased, while in the second it will be increased. Let us now suppose this reservoir very small as compared with the delivery for each stroke; then the included air will become more and more compressed as the column rises. At the instant when the piston comes to rest this column will be acted upon by variable forces and f will increase rapidly to again decrease in the same manner.

Now let us suppose that the bottom of the reservoir is closed by a second cylinder or column equal to the first.

The air being compressed by the motion of the first, then the second column of liquid will be acted upon by an increasing pressure of the air, and will be set in motion by a variable acceleration, depending each instant upon its mass, upon the air pressure in the small reservoir, and upon the pressure against which it acts upwardly. Hence during the first part of the motion, or while the piston causes the column to rise, the air is compressed and sets the second cylinder or column above in motion. During the second part of the motion the second column will take decreasing velocities due to accelerations f, which after having attained their maximum sooner than before, caused by the accelerated displacement of the first column, will decrease rapidly on account of the slowing up of the second column, and of the motion of the first. The forces p are therefore very variable, and may even become negative. These conditions are evidently favorable as they decrease the shock of the valve while closing under the impulse of the piston at the beginning of its upward stroke.

The pressures in the reservoir due to a certain volume of column will be greater as the reservoir is smaller. It is therefore easy to regulate the values of p by regulating the admission of air at each stroke by properly varying the size of opening of the air inlet.

If the hight of lift varies the work per stroke will vary likewise, the volume of air admitted will occupy a space inversely proportionate to the hight. The values of p will increase in like proportion, and will have greater variations, consequently the values of f will also be greater. Hence for greater lift the admission of air must be diminished. Consequently we say that the presence of air produces the following results: 1st, it modifies f at every instant by communicating fluctuations which depend upon the ratio of the quantity of air admitted during each stroke, and the weight and hight of column of water discharged, and 2d, it modifies the absorption of work, which instead of being transmitted instantaneously by one blow to the entire moving column, is propagated by a wave, the pressure side of which is produced by the impact of the piston, while the expansion side is caused by the variable forces which produce the negative accelerations f.

It becomes necessary to multiply the equation which gives the delivery per revolution by a coefficient $\varphi\ h$ which is a function of the hight, and we will have,

$$Y_1 - Y = \varphi\ h\ V.$$

As the experiments have thus far all been made with only one apparatus, solely to determine its practical value, they have not enabled us to determine values for $\varphi\ h$ for any given size to deliver water at a stated hight.

Changing the Suction System of a Pumping Engine.*

BY F. W. DEAN.

Recently the city of Taunton, Mass., brought water from the Lakeville ponds, some seven miles distant, to their waterworks pumping engines, through a 30-inch main, and under a head of 30 pounds pressure at the engines. Before this was done the engines had raised water 21 feet, by suction, from a basin fed by springs along the edge of the Taunton River.

As the new supply came into town under a head, it was decided to connect the new main directly to the suction pipe of the Gaskill engine, and thus secure an obvious economy in pumping water. Accordingly,

* Presented at the New York meeting (December, 1894) of the A. S. M. E.

the writer was asked by Mr. Desmond Fitzgerald, member A. S. C. E., consulting engineer to the city of Taunton, to prepare a design for the new suction system, and to arrange it so that the engine could either take the water as before from the old basin, or under a head from the new supply. As the case is one of interest and possessing some novelty, it is now presented to the Society.

In preparing the design, the obvious possible difficulty of using the same pump valves without additional springs or weights to seat them promptly under the new conditions presented itself, as well as the importance of effectively absorbing the inertia of a 30-inch column of water several miles long.

When the change was completed and the engine started under the head, to the surprise of everybody it worked as quietly as under the old system, and has so continued, without any change in the valves. The engine makes from 7 to 15 revolutions per minute under domestic pressure, and under fire pressure (the direct supply system being used) 10 to 25 revolutions per minute, and to this slow speed is doubtless due the success of the valves in both systems.

The methods of absorbing the inertia of the surge of the 30-inch column of water were two in number. There is an air chamber 4 feet in diameter and some 15 feet high placed over the extreme end of the supply main, that was considered ample in size to meet any fluctuation in pressure, provided it was kept properly supplied with air. In order, however, to avoid any rupture or dislodgment of parts when the air chamber is improperly filled, seven 6-inch-spring relief valves were designed to allow the water to escape to waste when the pressure reached a prescribed maximum (Fig. 1). While these valves cannot provide the elasticity which is desirable in handling water, and which the air chamber amply supplies, they limit the pressure to which this water can rise when any unusual surge occurs. The occasions of such occurrences are sometimes when reducing the speed of the engine from fire to domestic service. The valves are set to lift at 40 pounds per square inch, and they successfully limit the water pressure to that amount.

The relief valves are made with a spherical jointed spindle and nut, as shown in the engraving, in order to allow them to seat squarely if the springs should tend to incline them. They are grouped on a bowl-shaped casting covered by a light cast-iron cover, from which the waste pipe passes (Fig. 2).

The waste water from the relief valves is conducted to the old pump well, and the fall of the water into the well forms an audible tell-tale of their operation.

The engine is of the usual Gaskill form, of the following general sizes:

Diameter, high pressure cylinder	16 inches.
" low-pressure "	32 inches.
" pump plungers	18 inches.
Stroke of each piston	28 inches.
" " plunger	28 inches.
Rated capacity in 24 hours	4,000,000 gals.
Number of revolutions per minute, domestic pressure	7 to 15.
Number of revolutions per minute, fire pressure	10 to 25.
Suction lift, old system	21 feet.
Suction head, new system	69 feet.
Steam pressure by gauge	75 pounds.
Coal used in 24 hours, old system	about 2,600 pounds.
Coal used in 24 hours, new system	about 1 900 pounds.
Saving in coal	about 27 per cent.

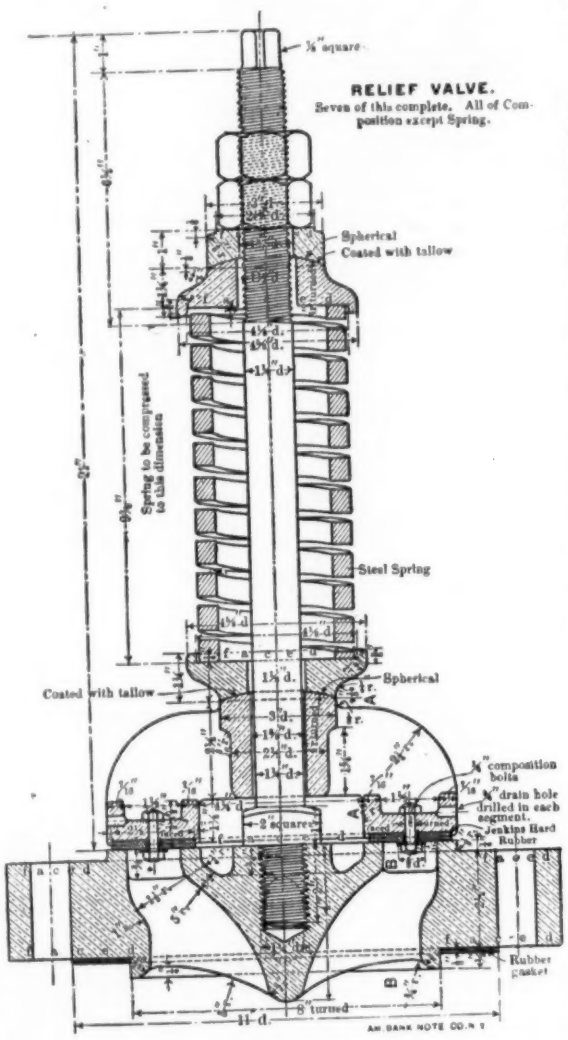
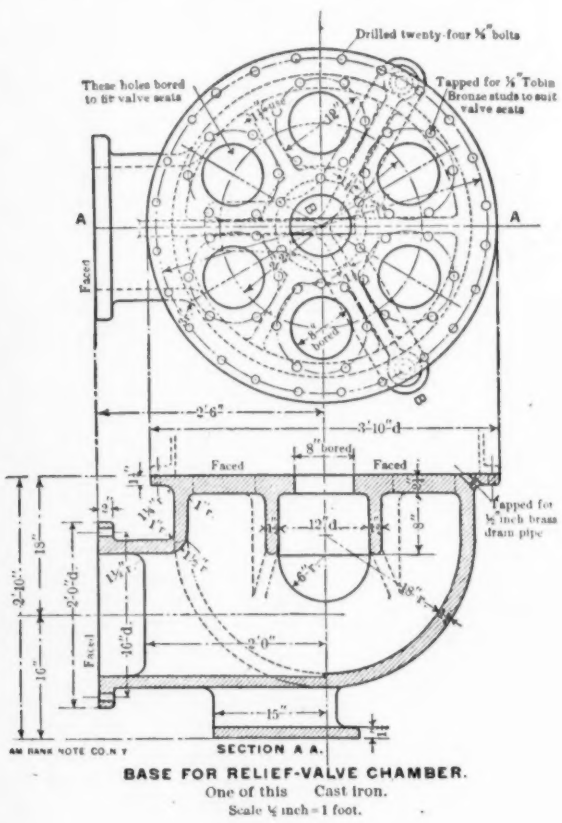


FIG. 1.


Drilled twenty-four ¾" bolts
These holes bored to fit valve seats
Tapped for ⅜" Tobin Bronze studs to suit valve seats
Faced
8" bored
Tapped for ½ inch brass drain pipe
SECTION A A.
AM. BANK NOTE CO. N. Y.

BASE FOR RELIEF-VALVE CHAMBER.
One of this Cast iron.
Scale ½ inch = 1 foot.

FIG. 2.

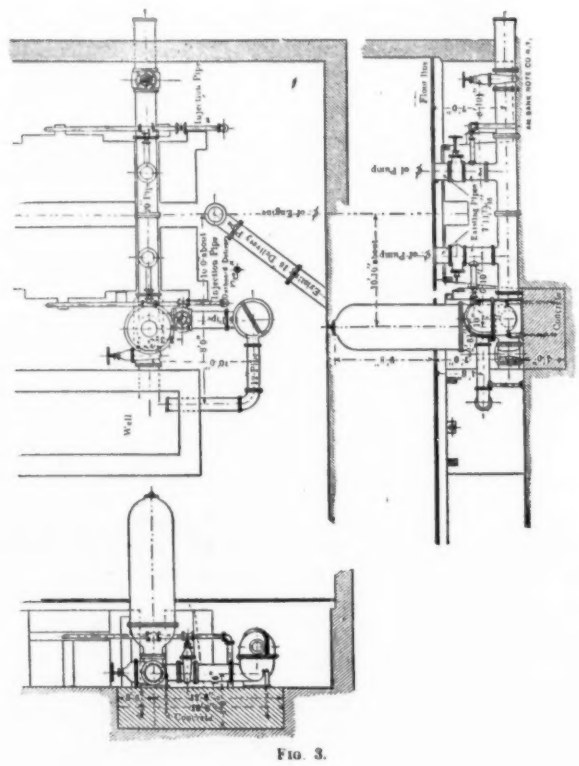


FIG. 3.

CHANGING THE SUCTION SYSTEM OF A PUMP.

Blacksmithing Three Hundred Years Ago.

In a recent issue of *The Engineer* (London), Mr. Ewing Matheson calls attention to a piece of ancient iron work—an anchor—that was dredged up from the wreck of one of the vessels of that famous fleet known as the Spanish Armada, which, setting out to invade Britain in 1588, was annihilated by the superior tactics and fighting power of the English seamen.

The anchor, which is thickly encrusted with marine growths, measures 5 feet across the flukes and 10 feet from crown to head, and the weight is estimated as being about ¾ ton.

The forging is supposed to have been done at the Spanish naval stronghold at Cadiz.

International Building Trades' Exhibition in London.

In March next there will be held in London an International Building Trades' Exhibition, which, to judge from the information in our possession regarding it, will be of considerable importance to builders generally, and especially to those who may have any specialty used in building which they may desire to introduce to the British or European building trades. Mr. G. M. Callender has charge of the American and foreign sections of the exhibition, and will furnish full particulars if addressed in care of The International Building Trades' Exhibition Co., 222 Strand, London, W. C.

It is being discovered that loading locomotives by number of cars hauled is too indefinite, and actual load is being considered.

LETTERS FROM PRACTICAL MEN.

Making Shop Drawings.

Editor American Machinist:

In reply to criticisms of C. S. Beach and "Two Foot Rule," I admit that it is a difficult thing to logically establish a rule limiting the size to which inches only should be used in marking dimensions on drawings. If the 2-foot rule in common use is to be chiefly considered in deciding this, then the only logical way to mark sizes would be as Mr. Beach suggests: All sizes less than 2 feet in inches, and all above that in multiples of 2 feet, and inches up to 23 inches. This is the only way to save the brains of those poor fellows to whom addition and subtraction are such a struggle. It is not all a saving, however, for it takes more time and more breath to say 4 feet and 17 inches than it would to say 65 inches, when the size is stated verbally, and it also takes more time and more space to write it. It is the universal practice to designate the size of machines in inches instead of feet. The diameter of boilers, the bore and stroke of engines and pumps, the swing of lathes, the size of rolling mills and many other kinds of machines. The reason for this is that it is easier to speak, write or print it that way. To the draftsman it makes but little difference, because the most of his calculations are made in inches, and he is so accustomed to using both feet and inches that the adding and subtracting does not terrify him much.

In placing the limit at 3 feet, I did not do so because it was a yard, but because I thought it ought to be more than 2 feet, and now I would favor making it 100 inches, for it seems to me there are more good reasons for doing so than to stop at 2 feet. The fact is a 2-foot rule is only a kind of guessing stick anyhow, and when any one wants to really measure anything more than 2 feet long, a steel tape line or surveyor's chain is the thing to use for a dimension that does not require anything more accurate than a 2-foot rule. Therefore it seems to me the 2-foot rule argument is too weak in the joints to stand alone against all the good points in favor of the use of inches for larger dimensions.

Any size less than 100 inches can be written with two figures, if in inches only, but if feet are used it sometimes requires three figures, and always a foot mark for every size above two feet.

When mankind are farther advanced in civilization, and have better sense, we will make the foot 10 inches, instead of 12, for uses where feet are wanted for a unit, and, in the meantime, it will be going in the right direction to get away from the 12-inch foot, by gradually leaving it to its fate along with those fellows to whom the 2-foot rule is the precious standard.

I thank Mr. Beach for the amendment to Rule 7, regarding the division line for fractions, for I intended to have that in, but somehow overlooked it.

In the interesting article on "Figuring Drawings," by Mr. Oberlin Smith, he says one of the attributes of a good drawing is "*definiteness*, that there may be no possible chance of one observer being in doubt, or two observers having different opinions in regard to the meaning expressed." Truly that would be a most valuable quality, but I believe it would be impractical and almost impossible to make all drawings so definite that no man in the shop could misunderstand them.

I have been amazed at times at the wonderful capacity that some men have for misunderstanding drawings and discovering wrong ways of doing work.

For such men a drawing would have to be made in the highest style of art in black and white.

Mechanical drawings are composed largely of a conventional arrangement of lines and signs which are used to convey information to those who have learned what the signs and lines are intended to represent, and only those who have learned this can or should be expected to read such drawings correctly.

The best that can be done is to agree on

as simple and convenient signs as will answer the purpose, and to prevent mistakes employ only those who have been educated to a knowledge of their accepted meaning.

Mr. Smith shows a specimen of figuring an ordinary hexagon nut, "with perhaps the fewest lines and characters possible to express the whole idea involved." It looks all right to me, but if it should fall into the hands of one of those fellows of wonderful capacity he would likely cut a left-hand thread in it, and make it 1⅛ inches diameter across the corners. I need not dwell any

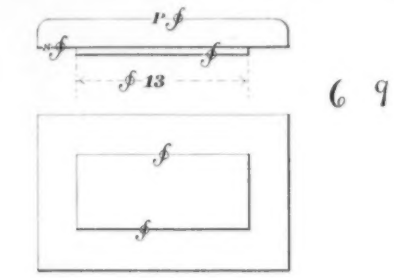


Fig. 3

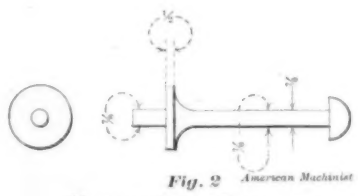


Fig. 2 American Machinist

MAKING SHOP DRAWINGS.

longer on this idea, perhaps, for no doubt Mr. Smith has known it all the time, only he did not say so.

I would respectfully suggest that there is a better way of making figure three than he shows in his model group. The objection to the 3 with straight top is that on a soiled blue print it may easily be mistaken for a 5. I think it should always be made in the regular printer's style, as used in the AMERICAN MACHINIST, and I find it easier to write that style than the straight top.

The difficulty about 6 and 9 being the same shape I have met by making them different in shape, as shown above, Fig. 3, and I have not yet found a single instance where one was mistaken for the other.

At Fig. 3 is shown a method of marking drawings to show which surfaces are to be finished.

It is by the use of a sort of letter f crossing the line which shows the surface to be finished, and having a small circle on the line. The small circle is to definitely indicate the surface to be finished, where two lines are close together so the f crosses both lines, as shown on lower surface of Fig. 3. The circle is made free-hand, and also serves to make the finish sign prominent and peculiar. This sign may also be used to show that a figured dimension is from one finished surface to another, as shown in the dimension of the raised spot 13 inches long. To indicate the kind of finish desired, the sign may be preceded by a letter, as shown at Fig. 3, where s means a scraped surface, and p means a polished one.

The kinds of finish could, of course, be indicated in the same way that Mr. Smith uses—the straight marks.

I think the merit of this sign is that it is prominent, and not liable to be overlooked, and is peculiar and not liable to be mistaken for anything else. It might be mistaken to mean feet when used in a dimension line, as shown at Fig. 3, and that may be a serious objection to such use of it, but I have not yet had any such mistake occur.

Mr. Smith objects to the use of reversed pointers where there is not room to get the dimension and points inside, and suggests spreading projected dimension lines as being more definite and consistent.

There are some places where that cannot be done, and at Fig. 2 is shown a method of using the outside pointers, which is probably not liable to be misunderstood, though I do not think it any better than the usual plan of reversed pointers as used for the same purpose.

As an attribute of a good drawing, "completeness, that there may be no necessary information omitted," is, of course, a valuable quality, but there are very few drawings made that are complete, if judged by that rigid definition.

I have not yet seen a satisfactory plan of indicating the degree of accuracy required for each finished dimension. The best plan I have seen described is the one in which the allowable variation is stated in decimal parts of an inch, and intended to be measured with a micrometer, or with limit gauges. This method is practical only for sizes up to, perhaps, 24 inches, or where large numbers of duplicate pieces are made. The usual plan for general work is to depend on the judgment of the foreman and machinists to decide on the accuracy of the dimensions. The result is that frequently much time is wasted in making some things more accurate than required, or the work is not made good enough, and must be thrown away or done over again.

No drawing is complete unless it tells the machinist the required accuracy of each finished dimension, so he can make it without verbal instructions; without knowing where it is to be used, or what to be used for, and without wasting time making it more accurate than required. Will Mr. Smith tell us if he makes and uses drawings so complete as that, and, if so, how he accomplishes it?

BELL CRANK.

A Peculiar Hoist—Calipers and Magicians.

Editor American Machinist:

I saw the form of hoist shown in Fig. 1 used as a stump puller in the northern part of Maine about 16 years ago. Fig. 1 is a side view, and will, I think, make its construction quite plain.

The hook shown at the bottom is for attaching the load, and the eye at the top was attached to a tripod.

The central vertical piece and the two side notched pieces were of iron about 2½" x½", the lower cross lever being somewhat wider, but of the same thickness and double, so as to journal the two side notched pieces and the hook between.

There were four eyes, as at *A A A*, to which were fitted wooden bars, so as to increase the leverage. In operation, one or more men would pump on each side, the pawls or links *B B* rising and falling automatically, and by so doing changing the fulcrum from one side to the other alternately, as shown.

As will be seen, such a hoist can be made to magnify force a great many times without excessive friction, as in the common forms of screw hoists.

This hoist was designed so as to be made with the means at hand in a country blacksmith shop. It seems to me that this thing could be got into better shape. I believe it was a patented device, but the patent must have expired by this time.

In your issue of November 29th, "Easy Way" says he believes he is safe in saying that spring calipers are in daily use in the hands of the fine gauge makers, and, "in their sensitive fingers, the spring caliper detects differences as certainly as any tool ever used." I believe if "Easy Way" will investigate this matter he will find there is no safety in such a remark. I am not in position to speak positively, but from what I have seen, if spring calipers are used at all, it is only for rough measurement. A pair of very light spring calipers, as shown in Fig. 2, might be all right in the hands of a magician, just to show the tricks he can do with them as a matter of satisfying curiosity, but this is not the purpose of gauges or calipers in modern shops. What a man perhaps *can* do has nothing at all to do with what he *should* do in many cases. I have yet to see (and I have seen a great many try) a man who can measure as closely with a caliper, as shown in Fig. 2, as with one as shown in Fig. 4. Let us consider the requirements of a good caliper or gauge.

Fig. 5 is my idea of the ideal, but in this as in many other things, the ideal will not materialize in practice every time.

If we want something to gauge small plugs of only a few ounces in weight, where it is convenient to use a gauge fixed and carry the work to it, then Fig. 5 is a good form, and is about as near the ideal as is necessary.

In this case it is not an example in the higher mathematics to figure out just the correct amount of material to offset the strains, but more a question of liberality in paying for a chunk of metal, bearing in mind that great weight gives great rigidity and will cause the thing to stick to the bench.

When we come to measure large work, where it is impracticable to take the work to the gauge, we must have a gauge that we can take to the work, and this requirement changes the problem considerably. In this case we *want* Fig. 5, but its weight would be prohibitory, so it becomes necessary to make some kind of a compromise.

We do not want to give up rigidity, but we do want to get rid of weight and cumbersomeness, so the very best form to get the material into to resist strains is the proper form.

I do not want to take the stand that spring calipers have no place in a machine shop, but rather to show that they are best when kept in their place and not when they aspire too high.

When we consider Fig. 2 for rigidity, and compare it with Fig. 4, we find Fig. 4 a long way in the advance. Theory says that Fig. 4 is not so easily adjusted to size, but we know that if we follow theory we must have correct theory, and correct theory in this case must embrace some of the magician's work or skill.

Some might think it would require more of a magician to adjust Fig. 4 than to caliper correctly with Fig. 2, but I shall have to differ in opinion in this.

Fig. 2 has two weak points; the legs are not of the best form of cross-section, and the spring allows of being compressed by the

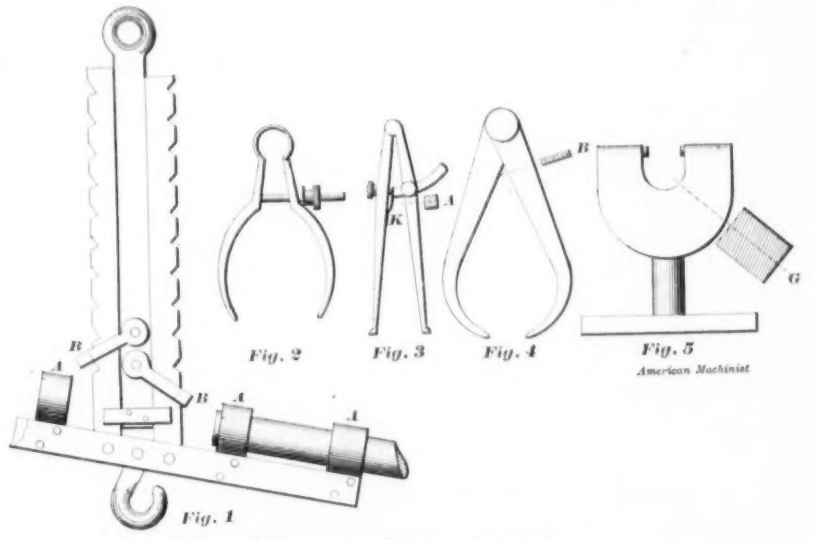


Fig. 1 *Fig. 2* *Fig. 3* *Fig. 4* *Fig. 5* American Machinist

A PECULIAR HOIST—CALIPERS.

leverage of the legs acting upon the screw as a fulcrum.

Fig. 4 allows of the best form of cross-section, and the friction joint is firm for the slight pressures it has to withstand.

I have heard men recommend Fig. 3 for an inside caliper. I consider this about the worst possible form, for the rigidity of the whole thing lies in the little spring *K*. This arrangement when used as it was intended (for an outside caliper or divider) is very good, except in the form of cross-section of leg, but it is putting a thing decidedly out of place when it is converted into an inside caliper.

There are men who can caliper quite well outside, but when it comes to using a common pair of inside calipers they are all at sea.

An inside caliper should be perfectly rigid, light and convenient to handle, so for the larger class of work, one in the form of a straight rod is the best, but for smaller work in long holes, there has not so far (to my knowledge) been found one better than the old-fashioned friction joint leg caliper. Of course, I am not considering standard plugs.

I believe every machinist should practice till he becomes enough of a magician to handle these inside calipers to advantage, but I am not advising anyone to stick to them after he has found something better.

Some think they can measure the diameter of a hole with a bar caliper with points made for that purpose, but anyone who tries will find he has about as awkward a tool as he could wish. It is too heavy in the back and will not enter the hole far enough. For inside measurements I prefer to use a sort of combination of sight and touch; that is, I watch the leg (where I can see it) and note how much movement I can get sideways, and at the same time I feel the touch, but, of course, for inside a long hole of small diameter this would be impossible, so the sense of touch can alone be relied on.

I believe there are many managers of machine shops who think just the same as "Easy Way" about gauges. They would not think of putting in one of grandfather's old wood-bed, chain-feed lathes and hiring a magician to run it, and so try to compete with a modern lathe and a modern man over it, so why should they, using spring calipers, undertake to compete with shops using rigid gauges? While we are all willing to admit that the machinist-magician is a first-class man, and one that is needed, and always will be, still, like every one else, there is a best place for him and he is best in that place. Where his skill is not required there is not sufficient pay for him. If you wish to make only a few high-class gauges he is just the fellow, but if you want them by the thousand you can get an equal quality at a lower cost.

A MECHANIC.

That Wonderful Cupola.

Editor American Machinist:

In reply to Mr. George A. True's statement, in your issue of November 15th, we are glad to supply him with the information he desires. The load of fuel charged on the bed is 275 kilos [605 pounds].

For instance, we begin to blow the wind "same having 30 centimeters [1.2 inches] water pressure" and three-quarters of an hour later we draw for the first time 600 kilos [1,320 pounds] and then keep on drawing.

We never do take the fuel bed into account for the reason that this remains the same, whether 2 or 15 tons are being melted.

Suppose we were to take the fuel bed in account, it will be seen at once that one time 184 kilos per 100 would be required and 63 only in the case of the 15 tons.

This goes to prove that our manner of compiling and omitting fuel bed is, therefore, the right and more accurate one.

The melted iron is very hot and as hot in the middle as at the end of the work. And trial bars show the same depth of chill at these three moments; showing the same heat; the composition of the iron remaining unchanged.

L'Administrateur Délégué,
H. BOLLINCKX.

It is reported that in 1896 Berlin is to have a refracting telescope, with 44 inches clear aperture, which would be 10 inches larger than our Lick and 4 inches larger than the Yerkes.

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NEW YORK, JANUARY 3, 1895.

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The Best Men Always in Demand.

The recent (and we may also say present) hard times again show, as has often been shown before, that, even in the dullest times, the very best men are in demand. This, of course, is no consolation to those who are not nor can be the best men, but it ought to be an added incentive to all who have the ability and opportunity to place themselves in the front ranks. A few days ago a manufacturer of our acquaintance was inquiring for a first-class tool maker—a man competent to take full charge of tool room work and to direct the work of others. He declared that such men were not easy to find, the hard times and stories of the large number of men out of employment notwithstanding. Plenty of men, he said, could be found who would declare their ability to do the work, but upon trial would be found not to be masters of their business.

We know nothing of this man's idea of what constitutes a competent tool maker, nor what he would expect to pay to such a man, and we know that, too frequently, alleged inability to find a suitable man for a given place comes from the fact that a five-dollar-man is needed and only "two-fifty" is expected to be paid. But in any event we believe it is true as he declared that really first-class men "do not grow upon bushes," nor are they to be picked up in the street, even in the dullest times.

We fully recognize the fact that it is not possible to eliminate the medium and the least able men. There can be no first-class men unless there are also inferior men with which to make comparisons. Every mountain must have a base as well as a top, and no matter what hights the general level of ability may attain, there must be men below the average in order that there may be men above it. We have no sympathy, therefore, with those who declare that the remedy for the hardships resulting from scarcity of employment lies in improvement of the individual as a workman, and we hope, as all thoughtful men must hope, that the day will come when even the lowest in point of efficiency, if honest and industrious, can always find work to do by which at least a decent living can be made.

But for the individual—for those mechanics who have sufficient ambition and interest in their business to make them readers of this paper, there is every incentive to go on to the fullest possible self-development.

Nearly fifteen years ago "Chordal" called attention in these columns to the fact that a man's career is, after all, of his own making; and, speaking of sixty selected men who, from the work-bench, had pushed on to become proprietors and manufacturers of machinery, he remarked: "Society never said to one of the sixty: 'We find a birth mark on you; twenty years from now come to us.' Society never said anything. The sixty said. Fortune never said, 'I see a mark; come to me.' Fortune never said anything. The sixty said. The five thousand in the shop never said to the sixty, 'We see a mark on you; shoot ahead, and we will lag and work for you.' The five thousand never said anything. The sixty said. Providence didn't chalk out a future for the sixty. The sixty did their own chalking, and left the five thousand to lean on Providence."

In discussing foundry matters during the recent meeting of the A. S. M. E., John Fritz said that he at one time wanted a competent foundryman, and one whom he knew nothing of could be had, he was informed, for $1,200 a year. He did not want him, but, said he, "If you can find for me a twenty-four hundred-dollar foundryman I would be glad to get him."

Within the fifteen years that have passed since "Chordal" wrote the words quoted above, other mechanics, then unknown, have forged ahead, and are now amongst those "whom not to know is to argue one's self unknown." And, whether seen or not, there was, fifteen years ago, a mark upon these men, easily discernible. They were marked by a reasonable ambition to be intelligent regarding their business; they preferred to retain their own and others' respect by conducting themselves as gentlemen, and not as blackguards. At the same time they have sacrificed little, if any, real enjoyment and satisfaction, but have found part of their enjoyment and satisfaction in being mentally alive and interested in their work, and in knowing that they were not being outstripped by every one else engaged in it.

We frequently receive letters from such men. One is before us from a machinist who is now proprietor of a machine shop. In his letter he says, among other pleasant things, that ours is "the only real paper that gets right down into the machine shop and appeals to real machinists who appreciate the staff of life when they see it. The AMERICAN MACHINIST has been my constant friend for fifteen years, and to it I am indebted for many a clear path pointed out, from which I might otherwise have been led to disastrous consequences."

Though this man seems to give to this paper the chief credit for his success, the prime cause of it has been, of course, his own efforts, in which he has been helped by his reading of, and contributions to our columns. The principal cause of a man's success must always be within himself, and if it is there he will seek and obtain technical publications and such other aids as will be useful to him.

Our Question and Answer Column.

We desire to call the attention of our readers to an addition which has been made to the heading of our "Question and Answer" department.

This department of our paper involves a great deal of labor, and that it is popular is shown by the fact that we receive many more questions than can possibly be answered promptly, even if we had nothing else to do but to sit down and write answers to them immediately upon receipt; and while we will, of course, do the best we can, our friends must not assume that all knowledge is at our immediate command, and that a problem which perhaps has baffled them for weeks or months, can in every case be solved by us in ten minutes and the answer sent by return mail or printed in our "next issue." Where it is important that an answer be received at once, the question should not be sent to us, because it very seldom happens that circumstances are such that we can give it immediate attention, especially where an answer involves considerable research and consulting of authorities. And it should be remembered that we require in every case the full name and address of those who correspond with us. There is no exception to this. When a person lives in a large city, street and number must be given; failure to do this often results in dissatisfaction, simply because our letter asking for further information or replying to the query (which we sometimes prefer to do by mail) is returned to us undelivered, because the person cannot be found. Then the whole matter has to go into our waste basket.

We are glad to have our readers ask questions, but questions must relate directly to our line, must be clearly stated, must be accompanied by full address, and must not be simply mathematical puzzles of no particular interest to machine constructors.

An Automatic Wage Regulator.

A press dispatch informs us that there was introduced in the U. S. Senate recently a resolution instructing a committee of the Senate to report as to the availability and advisability of establishing a "national unit of value of labor, wherewith to regulate wages automatically." We do not understand just what is meant by this scheme, but we feel safe in saying that the invention of such a unit of value and automatic regulator would be hailed with delight by all who receive wages, if only it regulated them high enough and in proportion to value of service rendered, while those who pay wages would also welcome an invention which would relieve them of the responsibility of fixing wage rates and would protect them from the disasters which follow from paying a rate either too much below or too much above those paid by competitors.

We haven't much faith in automatic wage regulators, but the contemplation of the great boon they would be to wage earners and wage payers is fascinating

We hope none of our readers will receive a very serious shock when they note that certain words much used by us and by mechanics generally, are, in this and succeeding numbers, spelled somewhat differently from what we have heretofore spelled them. We can see no use in placing an e in the word hight; we can see no use in an extra m and an e on the end of program; we can see no use in ue on the end of catalog; and, as our new Century Dictionary gives us the authority to adopt the shorter and more sensible spelling of these words, we shall so spell them hereafter.

Literary Notes.

Our worthy contemporary, *Power*, celebrates the completion of its tenth year of existence by a special number for December. It has deserved and has attained success among the leading technical journals of the world.

Our bright Southern contemporary, *Dixie*, also celebrates its tenth anniversary with a special and very attractive issue for December.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(1) H. A. C., Fort Wayne, Ind., writes: Kindly give title of a good, practical book treating on the construction of gas engines. *A.*—"The Gas Engine," by Dugald Clerk, is a good book.

(2) H. O. S., Watsonville, Cal., writes: I should be pleased to know of a book treating on electricity suitable for beginners to start with. *A.*—"Magnetism and Electricity," by S. P. Thompson, is a good book.

(3) W. K., Cambridgeport, Mass., writes: Please give me a method for laying a pattern for a pipe which is rectangular at one end and circular at the other end. *A.*—Use the same method as given in our issue of December 20, 1894, employed for laying out a pattern for a pipe connecting a rectangular to a circular section.

(4) J. H. C., Crawfordsville, Ind., writes: Kindly define the term "fire crack" in a boiler. *A.*—The failure of iron fire-boxes is generally caused by blistering, the failure of steel fire-boxes is generally caused by cracking; hence we may define the term "fire crack" as a separation of two parts of a steel fire-box sheet, with or without a noticeable space between them. 2. On ocean steamers of the "New York" class, are the Scotch boilers placed one above the other? I claim that they are not set in this way, am I right? *A.*—Yes.

(5) M. & L., Oxford, N. S., write: In making small articles of cast-steel under a drop hammer, we have trouble with the dies breaking and small cracks coming in the edges of the die. What will prevent this, and what kind of steel is best for dies? *A.*—We cannot say specifically what kind of steel is the best for dies, except to say in a general way that it is a steel made by a reliable steel maker for the especial purpose of making drop dies. The small cracks about the edges of the impression are caused by the rapid heating of those parts of the die by the absorption of heat from the work, and, so far as we know, there is no way of preventing it. By looking through the back numbers of our paper, you will find this subject treated at length by B. F. Spalding, in his articles on "Practical Blacksmithing."

(6) R. B. L., Bridgeton, N. J., writes: Your kind solution of my problem relating to the volume of a stone block does not give the same results as I obtain by two entirely different ways, both of which give the same result. I therefore ask you to kindly criticise my work. After my first solution I found a much simpler way of obtaining the

same answer, as follows: I add the hights of the four vertical edges, $48 + 36 + 9 + 7 = 100$ inches; then dividing by the number of these edges I obtain $\frac{100}{4} = 25$ inches for the mean hight; the base being 50 feet square = 600 inches square, we have for its area $600 \times 600 = 360{,}000$ square inches, and $360{,}000 \times 25 = 9{,}000{,}000$ cubic inches, or $\frac{9{,}000{,}000}{1{,}728} = 5{,}208\frac{1}{9}$ cubic feet in the block. *A.*—The rule which you say you have found is not new, it is given in works treating on mensuration. It can be correctly applied to all cases in which a right prism is cut by *one* plane, but the dimensions of the parallel edges and the sketch of the block, as originally sent to us, show that the block is not cut by *one* plane, because these dimensions cannot be obtained, unless the block is cut by *two* planes intersecting each other in one of the diagonals of the upper face. You have fallen into an error in overlooking this fact.

(7) C. M. K., Irwin, Pa., asks: What will be the safe speed for a cast-iron pulley 102 inches diameter, 31 inches face, 8 arms? Please give rule for finding the speed, and settle a dispute. *A.*—For finding the bursting speed the following rule may be used: Divide the ultimate tensile strength per square inch of cast-iron by 0.1, find the square root of the quotient; the result will be the velocity of the center of the rim in feet per second. Or, in symbols, we have

$$\sqrt{\frac{s}{0.1}} = v,$$

in which s = ultimate tensile strength per square inch of cast-iron, and v = velocity of the center of the rim in feet per second. If the metal in rim has not been decarbonized at all by remelting, the ultimate tensile strength per square inch should not be assumed to be greater than 10,000 pounds. Under these conditions the velocity of the rim to burst it will be

$$\sqrt{\frac{10{,}000}{0.1}} = 316 \text{ feet per second,}$$

or $316 \times 60 = 18{,}960$ feet per minute. For safety in practice the velocity should not exceed one-third of the above. Of course it is here assumed that arms are correctly proportioned for the stress which they will have to resist.

(8) X. Y., ——, writes: Please give me the rules for computing the size of keys and key-ways in shafts. *A.*—In practice the following empirical rules are probably more frequently used than any other. Breadth of key = ¼ diameter of shaft plus ⅛ inch; mean thickness of key = one-half its breadth; depth of key-seat in shaft equal to the depth of key-seat in hub, measured on the center line of the mean cross-section of the key, and not on the side of the key; taper of the key ⅛ inch to the foot. Keys designed in accordance with the above rules have generally an excess of strength. When wheels or pulleys transmitting only a small amount of power are keyed to large shafts, the dimensions of the key as found above must be reduced. In cases of this kind we first find a diameter smaller than that of the shaft by the following formula taken from Professor Unwin's "Elements of Machine Design:"

$$d = \sqrt[3]{\frac{P \times R}{360}} \qquad (1)$$

in which P = the force in pounds acting at the circumference of the wheel or pulley, R = radius of the pulley in inches, and d = diameter smaller than that of the shaft. The rules as given above can now be applied using the diameter as computed by formula (1) in place of the actual diameter of the shaft.

(9) W. A. C., Chicago, Ill., writes: I am getting ready to build a mill, one side of which will have to act as a retaining wall and resist the pressure due to earth 42 feet 6 inches deep. This wall is of stone laid in Portland cement. It is 2 feet 9 inches thick at the bottom and 21 inches thick at the top. I am not certain that I have made walls thick enough to withstand the pressure of the earth. I know of no rule or formula by which the thickness of the wall can be computed, and so I wrote to you. *A.*—The thickness of the wall depends somewhat on the nature of the surrounding soil. It should also be made strong enough to resist the dangerous pressure caused by tremors, and this cannot be computed. Taking everything into consideration, we should make the thickness of the wall at the bottom equal to $h \times .352$, in which h = hight of wall in feet. According to this, the thickness of the wall will have to be $42.5 \times .352 = 14.96$ feet. Of course, the end walls of the building and the two buttresses, shown on your drawing, will stiffen the wall, but this will put you on the side of safety. In any case you will have to conform to the Building and Fire Ordinances of your city, and these may admit of a slight reduction of the thickness as given above, but we know that the thickness you have given will not answer the purpose. Such a wall may stand for a short time, but it will bulge in time and may lead to disastrous results.

(10) G. M., South Framingham, Mass., writes: Kindly compute the horse-power from the inclosed card. My engine does not run to suit me, and I took a card from it. Let me know where the fault lies. It is a vertical 8x8 engine running at the rate of 200 revolutions per minute. When the card was taken the gauge showed a boiler pressure of 68 pounds. *A.*—According to the card, the mean effective pressure is 16 pounds per square inch of piston. The area of the piston is 50.265 square inches, and the piston speed is 266.6 feet per minute. Hence the horse-power of the engine is

$$\frac{50.265 \times 16 \times 266.6}{33{,}000} = 6.5.$$

In this computation we should have taken into account the area of the piston rod, but since its diameter is not given we have neglected it. According to the card, the initial pressure is 48 pounds only, while the boiler pressure is 68 pounds. We are of the opinion that this reduction is mostly due to a throttling governor which the cards seem to indicate you are using; but to whatever this reduction may be due, the cause should be removed, the initial pressure increased, and an earlier cut-off given. With these changes you will have far more satisfactory results than at present. 2. Kindly give me the title of a good book on indicator practice. *A.*—"Indicator Practice and Steam Engine Economy," by F. F. Hemenway, is an excellent work.

(11) G. H. M., Cleveland, Ohio, writes: What is the average weight in pounds per H. P. of boilers and engines (not including main shaft and screws) of the high-class machinery of the White Star and Cunard liners? *A.*—The variation of weights for different vessels is such that some specific example should be referred to, rather than an average. In the "Kensington," a recent addition to the Atlantic fleet, built by J. & G. Thomson, of Clydebank, the engines (twin screw) of 8,300 I. H. P. weigh 1½ ton (2,240 lbs.) per H. P., as do also the boilers, or a total of 6 I. H. P. per ton of driving machinery, including shafting and propellers. The engines (2) are quadruple expansion, the cylinders being 25½', 37½', 52½' and 74' diameters by 54 stroke, and the steam pressure is 200 pounds per inch. This is a vessel built for continuous service, at full power, and is the largest cargo carrier in the world. Speed, 15.8 knots. The weight of engine, *exclusive* of shaft and propellers, is not known—such data is very hard to procure. The screws would probably weigh 20,000 pounds apiece, or 40,000 pounds total, and the shafting, which is 14 inches diameter, would run close to 100,000 pounds per line, or 200,000 pounds total, making 240,000 pounds for shafting and screws, or, say, 30 pounds per H. P., which, being subtracted from 373 pounds (the total for engines and boilers), gives 343 pounds for boilers and engines, up to after coupling of crank-shaft; or, 156.5 pounds per H. P. for engine alone up to crank-shaft coupling. 2. How much coal per H. P. do these vessels burn? *A.*—The coal consumption runs from 1.4 pounds to 2.5 pounds per I. H. P. per hour, and a rough average is about 2 pounds per hour per H. P. At this rate the above steamer would consume nearly 200 tons per 24 hours, for main engines alone. The auxiliaries would add about 15 per cent. to this amount.

(12) C. C. N., Philadelphia, writes: What is meant by initial pressure? *A.*—The pressure at which any cycle or operation begins. In a steam engine it is the pressure in the cylinder, at or near the beginning of the stroke of the piston. 2. What is the volume of steam when it is at 60 pounds per inch above atmosphere? *A.*—At 60 pounds gauge pressure (= 75 pounds *absolute*) the steam in boiler is about 350 times the volume of the water evaporated. Or, a pound *weight* of steam at 60 pounds pressure above atmosphere occupies a space of 5.7 cubic feet. This is for steam termed saturated, such as that which has just been formed in a boiler. If superheated, the volume at any pressure depends on the circumstances under which such extra heat is imparted. 3. What is meant by pressure above the atmosphere? *A.*—The atmosphere exerts a pressure of practically 15 pounds per square inch at sea level on the average (14.7 + pounds per inch being the *yearly* mean or average value). This pressure is above zero or "*nothing*," and as such is what is termed *absolute* pressure. Boiler gauges measure pressure *above* atmosphere, since they show zero when open to the air. In steam pressure tables, pressures below 15 (or 14.7) pounds per inch are sometimes called minus, in the same way that *temperatures* are called minus when below the zero on the scale. 4. Is not the atmosphere the same weight at any hight that it is at the sea level? *A.*—The atmosphere is held to the earth by gravity, as is any other substance, and the pressure at sea level is due to the total weight of air above. The air being compressible is denser at the lower levels, since at elevated positions the column above weighs less by the weight of the column between the given position and the sea level below. These matters are treated in detail in works on physics, which you will do well to consult. A very clear work is Ganot's "Physics," trans'ated by Atkinson.

(13) B., Carmi, Ill., asks: What is commonly used for lubricating the slide rests, etc., of lathes? *A.*—Lard oil, or any good mineral oil. 2. I want a receipt for a good iron paint, one that will be very hard, and which will not crack and peel off. *A.*—Well boiled linseed oil, to which is added a suitable coloring matter, is recommended. If a dark color is required, burnt umber is preferable to any other pigment as a stain; it is a good hard dryer, and has many other good properties and mixes well with the oil without injuring it. The iron should be first well cleaned and freed from all rust and dirt; the oil should be of the best quality and well boiled, without litharge or any dryer being added; after it has been boiled add the coloring matter. The iron should be painted over with this, but should be laid on as bare as possible, as on this fact depends in a great measure the success of the application; for if there be too thick a coat of oil put upon the work, it will skin over, be liable to blister, and scarcely ever get hard; but if the iron be painted with three coats of oil, and only so much put on each coat as can be made to cover it by hard brushing, it is claimed that the same will preserve the iron from the atmosphere for a much longer time than any other process of painting. There are other good and suitable paints, which can be obtained from any first-class dealer in paints when he knows for what purpose the paint is to be used. 3. Which is the best and quickest way of cleaning paint and varnish brushes, especially those used in shellac varnish? *A.*—Paint brushes which have become hard can be cleaned by soaking them twenty-four hours in raw linseed oil, and then rinse them out in hot turpentine. Repeat this process till the brushes are clean. They may also be cleaned by washing them in hot soda and water and soft soap. Brushes used in shellac varnish can be cleaned by soaking them in alcohol. Your last question is too indefinite for an answer. State what you want to do, and we will endeavor to give you the desired information.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 12.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, H. F. Parker, Att'y, 26 Cort'ndt St., N.Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Best Presses and Dies for all sheet metal work, Ferracute Machine Company, Bridgeton, N. J.

Air Compressors for every possible duty. Clayton Air Compressor Works, 26 Cortlandt street, N. Y.

Our loose pulley oiler saves you labor, annoyance, money. Kridler Mfg. Co., Grand Rapids, Mich.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Emery, emery wheels, grinding machines and grinders' supplies, quick process and large stock. When in a hurry, buy of The Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F Hemenway Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid Published by John Wiley & Sons, 53 East Tenth street New York.

"Modern Locomotive Construction." By J. G. A. Meyer. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.

Condition and Prospects of the Machinery Business.

LETTERS FROM MACHINERY MANUFACTURERS TO THE "AMERICAN MACHINIST."

Acme Machinery Company (Bolt, Nut and Special Machinery), Cleveland, Ohio, write us:

We are obliged to report, that, in common with others, we have suffered somewhat from the general depression in business during the year now coming to a close, and our output has been about 25 per cent. below the average.

During these quiet times we have taken the opportunity to overhaul all our patterns and designs, and have made many improvements in construction and in methods. We also added during the year several new tools to our catalog, so that we can now offer a very complete line of bolt and nut machinery.

We look for a fair business the coming year.

American Watch Tool Co., Waltham, Mass., write us:

We cannot say very much about business in 1894. It started in extremely doubtful, but since September 1st has been increasing very gradually until we now have double the hands we had in December, 1893. Our prospects for 1895 are reasonably good, in fact, we think that we are getting more than our share of business in this line. From the general outlook at present we feel very much encouraged for the coming year. Have made no enlargements in our works, but trust we have made some improvements in methods. Our price for labor has changed but little; materials remain about the same, but our products are selling for less.

M. L. Andrew & Co. (Patent Twist Drill and Auger Bit Chucks, Wood Boring Machines and Agricultural Implements), Cincinnati, Ohio, write us:

The writer has just returned from a trip, and is pleased to say that the prospects for business after the new year are decidedly very encouraging. Our patent drill chuck and drill sockets are becoming great favorites with the machinists, especially those that have had experience in twisting of tangs on the taper shank drills. November and December were the two best months we have had in the past eighteen months. The prospects for the new year with us are good.

Bardons & Oliver (Brass and Ironworking Machine Tools), Cleveland, Ohio, write us:

Business with us is good, and has been during most of the past year. The prospects for 1895 appear to be even better than for 1894.

Berlin Iron Bridge Co. (Engineers, Architects and Builders of Iron Bridges, Iron Buildings, Iron Roofs, etc.), East Berlin, Conn., write us:

While we have been able to run our plant full time (with but slight exception) during the year 1894, yet, generally speaking, it has been at the expense of our stockholders and with the sole and only object of keeping our forces together and giving our men full employment. Notwithstanding our help have been so fully employed yet we have been compelled to reduce their wages to the very lowest possible point, in fact, to so low a point that once during the year 1894 we felt compelled out of sheer sympathy to raise the pay of all our employes 10 per cent., when, in fact, at this time we were getting a less price per pound for our finished product than at any time during the year. Never before have we been compelled to reduce the wages of our help to so low a figure per hour as during 1894, and we earnestly hope there will be no recurrence of this. We have, however, learned one lesson from the experience of 1894, and that is that American workmen when reduced below a given point lose all their energy and ambition, and we have found by a few experiments in different departments of our works that we can increase our production and not reduce the pay of our help, or, in other words, insist upon the help producing enough more work to decrease the cost of production and in this way save reducing the per diem rate of labor.

Eighteen Hundred and Ninety-five opens better. We believe the bottom has been reached and although we do not expect any boom, yet we do expect that business will gradually expand, and that the hard times of 1894 will soon be a thing of the past.

Billings & Spencer Co. (Machinists' Tools and Drop Forgings), Hartford, Conn., write us:

In regard to condition of business during

the year 1894, would say that our business has been about the same in proportion as the last six months of 1893; that is, we have done about one-half the business that we do in good times.

We have received good orders for the coming year for our new line of bicycle wrenches, and the electrical work has been very satisfactory during the past year.

In regard to prospects for 1895, it is a little early for us to give any information in regard to it, but we are in hopes that after the first of January business will increase, especially in our hardware specialties, which have been very dull for the past year.

Brown & Sharpe Mfg. Co. (Machinery and Tools), Providence, R. I., write us:

Our business of the present year has been as good as we had reason to expect during these dull times, though somewhat less in amount than that of last year. Commencing in January with 800 hands, the number was gradually increased, till in June 860 were employed. Latterly they have been reduced from time to time, till at this writing the number is 800 again.

The whole works was run ten hours per day, from March to October, but portions were operated eight and nine hours during the first and last part of the year.

The remaining two stories of the extension of our No. 1 building were added during the summer, completing the works. This extension is 163 feet long, 51 feet wide, four stories, with two wings, 73 feet by 51 feet, and 50 feet by 43 feet, making, without staircase or elevator towers, a total floor area of more than 50,000 square feet. The total floor space of all our buildings now exceeds six acres.

Twenty-four old machine tools were taken out during the year, and thirty-one new ones added.

Builders Iron Foundry (Founders and Machinists), Providence, R. I., write us:

When we consider the general condition of business the past year we are well satisfied with our record. All our works were operated full time up to November 26th, and during the first three months of the year the machine shops ran night and day, and for the last six months a number of the larger tools have been frequently run at night.

The season of the year has now brought considerable of our business to a close, and a number of our large contracts have been completed, so that we are now running only eight hours.

The business in the architectural iron or building work, from which we derive our name, has been nearly equal this year to that of last year, although the prices have been considerably lower.

We have been fortunate in obtaining a number of contracts for unusually large castings, so that, aside from castings to be used in our own machine shops, our foundry has been nearly as busy as last year.

The aggregate of the orders for our globe special castings for water works exceeds that of last year, and the Venturi meter has been even more favorably regarded, and its sales larger than we anticipated.

In June the Rice & Sargent Engine Company, of this city, was incorporated, and we arranged to build their engines. These engines are four-valve automatic cut-off, either condensing or non-condensing, single or multiple expansion, and important features of their design have recently been patented.

The chief decrease in our business has been in heavy special machine work, comparatively little of which has been required this year.

We look for a quiet winter, but hope that by spring business will, in a large measure, resume its normal conditions.

Chandler & Taylor Co. (Engines, Boilers, Saw Mills), Indianapolis, Ind., write us:

We beg to say, in regard to the condition of business, that we find there is no increase of inquiries or orders noticeable up to this time, but, of course, during the season from Thanksgiving to New Year's, business is not usually very brisk. However, we expect to see better times after the first of the year.

Cincinnati Milling Machine Company (Fine Machine Tools, Milling Machines, Universal Cutter and Reamer Grinders), Cincinnati, Ohio, write us:

With the aid of an increased foreign business we were enabled to employ the larger part of our force during the entire year, and at present are quite busy. The prices of labor, material and finished product have declined. We have added some new tools, and otherwise improved our facilities. During the year we designed and perfected an entirely line of universal and plain milling machines which will be ready for the market early in the new year.

Clayton Air Compressor Works (Air Compressors for All Pressures and Purposes, General Mining Machinery), Brooklyn, N. Y., write us:

With the extension of the field of usefulness for compressed air, and its adaptation to new lines of industry, the Air Compressor business is naturally a growing one, although the depressed trade conditions, which have prevailed throughout the year now closing, have prevented the adoption of these new applications by those to be benefited, on account of the initial expenditure necessary, though the resultant economy is unquestioned. The machinery trade, dependent upon new enterprises, or an extension of existing ones, is, of necessity, among the last to feel a revival of trade after a period of depression.

We have never, in the history of our business, received so many inquiries for our catalogs and circular matter, nor been called upon for so many proposals, quotations or estimates, as at the present time; and, while the volume of our orders continues spasmodic, with occasional periods of very good business, we assume the unprecedented number of inquiries to presage a healthy and steady improvement in trade early in the new year.

R. M. Clough (Gear Cutters, Special Machinery), Tolland, Conn., writes us:

Business for this year has been somewhat better than last year. I find in looking over my accounts I have done nearly double the business I did in 1893. Collections are and have been somewhat poor and not satisfactory at all. I have put some new tools on the market which have sold well; in fact, nearly every inquiry resulted in an order. I have put in some new tools during the year, but not as many as if business had been better. Hope to see my way to put in more the coming year. I really do not see much chance the coming year for business generally to improve, but for those who can put improved tools on the market I think the chances are better. I think prices generally are having a tendency to be lower.

Curtis & Curtis (Pipe Threading and Cutting Machines, Dies, etc.), Bridgeport, Conn., write us:

Considering the hard times business has been as good with us as could be expected. We have run full handed, and with the exception of a short time during midsummer, full time throughout the year. We had the plans drawn for a large addition to our works, when the hard times came on, and we shall go ahead with it as soon as the times improve.

We have taken advantage of this time to remodel many of our machines, and with the improvements that we have added, we consider them much better than ever. Of course, it has been a hard time for manufacturers generally, but our specialties have stood the strain splendidly, which we consider another proof of their excellency.

W. P. Davis (Machine Tools), Rochester, N. Y., writes us:

Business for the past year has been very light. Have had a fair trade in my machinery store but it has not been good. Business at the factory has been very quiet, although have been running most of the year on full time, but not with our full line of workmen. At present am running eight hours.

There has been a general improvement perceptible for the past few weeks and from the present indications we think we have reason to look for a fair business the coming year. I have had a large correspondence for the past few weeks which is a sure sign of an improvement in trade.

Have within the last year made quite a number of improvements in the various line of tools I build, especially in key-seaters and I now make a special 17-inch lathe that is especially adapted to general work of medium weight, also a lathe well adapted for tool room use.

The prices in all kinds of machinery have been generally decreasing, and there never was a time when machinery could be bought as cheaply as at the present time.

Detroit Twist Drill Co. (Graham's Grooved Shank System Chucks and Drills), Detroit, Mich., write us:

We can see quite an improvement in trade but perhaps we are situated differently than other drill makers, as we are making only the grooved shank drills, which system is undoubtedly superseding the old taper shank drills.

There is a constantly growing demand for the positive drive that will avoid the breaking of the tang on the taper shank drill. We have every reason to be encouraged and none to be discouraged at the outlook for the coming year.

J. H. Dunbar (American Packing Rings), Youngstown, Ohio, writes us:

The demand for my rings has constantly increased during 1894, and the outlook for the coming year is good.

Early in 1895 I shall increase and improve my facilities for making rings, and shall also add a new piston valve to my articles of manufacture. No change in prices in any direction is anticipated at present.

Egan Company (Woodworking Machinery), Cincinnati, Ohio, write us:

Trade has been about medium; some months better and some not so good. October was the best for 18 months; we held our own, however, and improved our plant somewhat and brought out many new machines.

Our export trade has been good and helped the volume of our business very materially, and it was never so acceptable as in the past two years, and if this government would only take up and renew the reciprocity treaties it would be and most certainly will be a great advantage, for by the rescinding of the reciprocity treaties we gave a valuable consideration and received nothing in return. Congress during this short session should by all means put back these treaties where they used to be, and it will give the United States a boom in foreign trade.

We hope our next letter will be a report of the times that we had in 1892.

J. A. Fay & Co. (Woodworking Machinery), Cincinnati, Ohio, write us:

We cannot say that our business transactions were entirely satisfactory during the year 1894. It was a series of waves. Orders and work fair at times and then falling back into the old channel that we all know something of. Under the circumstances, however, we are thankful, indeed, for that which we have received and pleased, too, that we have done so well.

We do not contemplate any improvements for the present. Prices of our products have been fairly maintained, but averaged lower than ordinary. Material can be bought always at bottom figures. Labor is unchanged and without a single feature. Our view of the future is that of hope, and we think we can see a little light breaking through the darkness. Should a further disturbance arise to stop the slight improvement at hand, the blame for it entirely can be placed right at the door of the present Administration and Congress. The manufacturers, business men and the people are willing and anxious to resume normal conditions, but will the politicians let them?

Ferracute Machine Company. (Presses, Dies and Other Sheet Metal Tools), Bridgeton, N. J., write us:

The year 1894 has been with us rather a quiet one in business matters. We have not made any enlargements in our works, and have added but few machine tools. We have, however, been making a number of jigs and other special appliances for cheapening the production of our presses and making their parts more nearly interchangeable. We have also been adding to our already considerable line of drawings and patterns, with a view to making a number of new sizes, especially in our large double-crank presses.

We have mostly completed the re-designing of our various styles of presses, making many of them very much stronger and heavier, adding more die room, longer adjustments, better facilities for variations of strokes to order, etc. A modified form of clutch has been experimented with and adopted—all the parts of this and the brake mechanism being much easier of access than before, as well as of such individually simple form as to be cheaply renewable.

We have had a moderate share of trade, and have kept a force of 50 to 60 men running most of the year on full time. Our capacity, not including foundry work, is for about 100 men. We have made no further reduction in wages than the 10 per cent. occurring in 1893.

We are moderately busy only, just now, but we think orders are slowly increasing in number and that perhaps after the first of the year there may spring up a fair amount of trade. Prices, however, are very low and profits extremely small—sometimes entirely *nil*

We shall be much disappointed if we do not get a considerably better trade and somewhat better prices a year hence.

Among other novelties brought out during the year have been a compact, low-priced, hand-fed, 150-ton, toggle, embossing press; an inclined straight-column cutting press; an automatic cartridge-cup drawing press for gang dies; an improved automatic indexing press for armature disks, etc.

Flather & Company (Machine Tools), Nashua, N. H., write us:

In regard to our business during the year of 1894, the first part of the year, we, with other makers in our line, suffered from general dullness, but during the latter half business has been much better. We are running full time and with nearly our full force.

Our new taper attachment lathe, which was illustrated in your issue of April 19, 1894, has proved a great success, and, together with our new shaping machine, has been a great help to our business.

We have during the dull times been engaged in making special tools and machines for our work, and improving and increasing our equipment. We are also bringing out a new 21-inch swing lathe. As to the future we do not attempt to prophesy, but if any business is being done, we expect to get our share.

Fox Machine Co. (Shapers, Milling Machines, Punching Presses and Small Tools, Wood and Ironworking Machinery), Grand Rapids, Mich., write us:

We are pleased to report that our business for the year just closed has been very satisfactory. We have had a good trade on ironworking tools, also on improved trimmers. Our hardware specialties, which we took up two years ago have met with increased sales, so that during the past year we have run full time, and in the last four months we have been increasing our force.

While we do not anticipate any rush of orders for 1895, we think there will be a steady increase in business, of which we expect to get our share.

There has been no material change in the price of labor during the past year, and very little in the price of materials, if anything, there has been a slight reduction in pig-iron and Bessemer steel, and it would seem from the fact that parties have reduced stock in hand to a minimum, that if there is any demand for machinery it will mean business for every one along the line.

Frick Company (Eclipse Machinery, Corliss Steam Engines, Ice Making and Refrigerating Machines, Steam Boilers, etc.), Waynesboro, Franklin County, Pa., write us:

Business during the early part of the year 1894 in our particular lines was very dull, our establishment running less than one-third its usual capacity. No marked improvement has been made during the year, except in the line of providing special tools and fixtures to cheapen production. Since November our business has been steadily increasing in volume, and we have to report a larger number of contracts taken than in any preceding year. A continuance of present conditions will soon push our facilities to the utmost, and bring our force of workmen up to normal conditions.

Gould & Eberhardt (Machine Tools, Gear Cutters), Newark, N. J., write us:

We have been fairly busy all the year, and considering the dull state of the trade, we think we have done our share

We have made the most of the opportunity offered by the dull period, to improve our equipments, and now feel that we are in a position to meet the demands of the critical purchaser, who *must have* much *better tools* than formerly, in order to meet the severe competition of both home and foreign manufactures in every line of trade.

The growing demand for our tools still continues, and the outlook seems very good for the coming year. We hope to receive a good trade.

Harrison Safety Boiler Works, Germantown Junction, Philadelphia, Pa., write us:

We consider we have been particularly fortunate in both the years 1893 and 1894, doing a fair business both years. This experience has been so exceptional among manufacturers, judging from all accounts, that we feel it must have been due to a combination of rather happy circumstances.

The volume of business in 1894 is somewhat less than usual, and at one time it threatened a heavy decrease, but it took a turn for the better and has been most encouraging for several months past.

The increased trade in our Cochrane heaters, "special" heaters, and Cochrane separators, has been marked and most gratifying. In one month we sold *ten tons* of the separators, and their merits are attracting much attention.

With the return of confidence, due to the elections, we decided to proceed with a large addition to our foundry which had been under contemplation but tabled owing to the depression. This building, now almost under roof, will be thoroughly equipped, and will largely increase our facilities.

We were obliged for a time to shorten our workmen's time, but, fortunately, did not have to lower wages, and trust that the workingmen of the country have now learned what a change in policy means.

Hendey Machine Co. (Machinists' Tools), Torrington, Conn., write us:

Our business for the year 1894 will be about the same in amount as for the year

1893. For the past four months it has been very good, and bids fair to be good the coming year. Prices have been lower than before the depression, but we hope the improvement in business which promises so well, will tend to advance prices a little, and bring them so there will be a little margin of profit left.

Wages with us are very little lower than for years past, as we made no reduction till May 1st. We hope to be able to bring them back to the old level soon.

We have during the year taken out a good many of our old machines, replacing them with new, and have put in a good number of the improved Hendey-Norton lathes, which we are now building exclusively, and which show an increased production over the old lathes.

The only building we have done during the year, is to build a new storehouse for our patterns. This was necessary, owing to the large increase in our patterns, owing to the many sizes of lathes we are now building. Our export trade has increased steadily during the year, and promises to be a very important part of our business. From present indications, we think the coming year will bring better business than we have seen the past two years.

Jones & Lamson Machine Co. (Screw Machines and Turret Lathes, Complete Outfit of Turret Tools), Springfield, Vt., write us:

Our product, the flat turret lathe, has been in demand mostly as a labor-saver for reducing costs, and very few sales have been made to new companies, or to old companies increasing.

With the exception of a slight boom in September, our orders have run very evenly throughout the year, showing a slight increase of 10 per cent. over the last six months of '93. We have run on two-thirds time, and have made no change in wages. Instead of reducing our selling price we have made several small but important improvements to increase the efficiency and accuracy of our machine.

Inquiries have been coming in much thicker than usual since election day, and we believe they will ripen into nearly the usual percentage of orders either late in the present month or in January. We are expecting a better business for '95.

G. W. Jordan (Planer Chucks), Worcester, Mass., writes us:

My trade for the first ten and a half months of the year has been very quiet, but for the last thirty days has been very good. The prospects for '95 are good.

Kempsmith Machine Tool Co. (Iron and Brassworking Machinery), Milwaukee, Wis., write us:

We feel more like answering than we did last year at this time, when we passed the inquiry in silence, as we had nothing to say about the condition of business. At present, we can say that we have run full time since January 1, 1894, with about two-thirds force until the 1st of September, and since then with a larger number of men than we ever employed before. We have brought out during the year some new milling machines, which have been received with approval by those to whom we have sold, and we are busily engaged in designing further additions to our line, and confidently look for a material increase in our business during 1895.

Wages and material are about the same as they were last year at this time, but the selling prices have decreased to such an extent during the year that the profits have to be looked for with a microscope. We tender you the compliments of the season, and wish your paper all the prosperity it so well deserves.

Link-Belt Engineering Company (Elevators, Conveyors, Fiber Graphite Bearings, Safety Boilers), Nicetown, Philadelphia, write us:

We have your favor of the 8th instant, asking for our view of the business of the past year and of the prospects for the coming one. The veteran who was asked for an account of the battle of Gettysburg summed up his experience in the brief reply, "Stranger, I was thar." We were "thar" during 1894, and when the coming year shall have drawn to a close, shall hope to report that we are on hand and satisfied with our position.

Lodge and Shipley Machine Tool Co. (Engine Lathes, Drills, Turret Lathes, Shapers, Pulley Machinery, Cylinder Boring Machines), Cincinnati, Ohio, write us:

The first eight months' business during 1894 averaged with last year's. Since August 1st business has been much more encouraging, and we have been adding steadily to the number of our employes. Since November 1st we have been working more men than ever before, and during much of this time have been making seventy hours per week.

The prospects for 1895 appear reasonably good. Should business continue, for sixty days, to increase as steadily as during an equal time past we will occupy increased floor space sufficient to double our capacity. We have put into our shops, during the past few months, fourteen machine tools, including the most improved lathes, planers, shaper, upright and radial drills, milling machines, universal grinding machine and turret lathe.

We note no change in price of labor over last year but materials of all kinds are some cheaper, while the prices of the finished product are extremely low. We note an unusual amount of "shopping" before the buyer is ready to place the smallest order.

We have taken advantage of the quiet time to get every machine on a "manufacturing" basis and the improvements in methods include many special devices for this purpose.

Volney W. Mason & Co. (Patent Friction Pulleys, Friction Clutches for Connecting Shafting, Elevators and Hoisting Machinery), Providence, R. I., write us:

In view of the general reduction in valuations now going on, we made 20 per cent. reduction in prices this year, also the same general reduction in wages of our employes, which was, under the circumstances of less expense in living, equally good in purchasing power, and in general acceptable to the more intelligent of our men who recognize the fact that with a greater purchasing power less money does the business all around; and promoting business eventually, if not suddenly (by reason of our values approximating the values of similar goods in other countries) prevents the importation of such goods as can be manufactured advantageously in this country, and places us on a better basis for selling to South America and other countries where we have European competition. Concerning the tariff, we consider the less restrictions placed by our government on free trade, the better, and if there must be a tariff for revenue, let the amount to be raised in this manner and its distribution on different articles be fixed by a specially constituted commission of seven members who can better do such business than our Congress, which cannot give the matter the attention the best interests of the country demand.

Meriden Machine Tool Co. (Forming Lathes and Special Machinery for Economical Manufacturing), Meriden, Conn., write us:

We have done considerably more than twice the business during the year 1894 that we did in 1893.

During 1894 we have added some machinery, and made several improvements in our methods; we have during this year, same as in previous years, made a specialty of forming lathes, and we propose to stick to this specialty as long as it does as well for us as it has in the past, and by so doing keep it at the front.

The present prospect is that 1895 will be away ahead of 1894 or any other year in our history.

Montgomery & Co. (Importers and Jobbers of Tools, Supplies, Machinery, Files, etc.), New York, write us:

Referring to your annual letter, would say that during the first eight months of this year our business was practically nothing, never in our experience did we run up against such hard times. However, the last three months have shown marked improvement and we have every reason to hope and believe that 1895 is going to help us as well as others to make up 1894 losses.

We take this opportunity of wishing you and all our friends who glance through these columns a Happy and Prosperous New Year.

Norton Emery Wheel Co. (Emery Wheels and Grinding Machines), Worcester, Mass., write us:

Business has been fair during 1894, and the prospects appear to be good for 1895.

We have not enlarged our works, having made ample additions in the previous year. Our methods of production have been still further improved, and we have also had time to slick up the shop outside and in, improving its general appearance. We have not cut down the price of labor, and are not able to purchase our principal material, viz., emery, any cheaper. The average prices of our product are not quite as high as during the previous year, although the difference is slight. Comparing eleven months of 1894, viz., from January 1st to December 1st, we find that it was a little less than for the same period of 1893, viz., 6 % per cent.

The net volume of business for the first six months of 1894 was 18 per cent. less than for the first six months of 1893, the latter being the best six months we ever had. The net business for five months, from July 1, 1894, to December 1, 1894, was 12 7/8 per cent. more than for the same period of 1893.

So far as we are able to judge, the total business for 1894 will be about the same as for 1893, which is quite satisfactory, in view of the fact that we did such a large business in the first six months of 1893; we not really feeling the effect of the hard times until after July 1, 1893.

New Haven Manufacturing Co. (Machine Tools), New Haven, Conn., write us:

Our business for the past year has been far from satisfactory as regards the amount of business, and usual profits. Within the past four months, we have experienced an improvement in business, and have increased our running time about 50 per cent., we have taken advantage of the dull times the past year to make very decided alterations and improvements in our patterns and in our methods of production. As to the prospects for 1895, we certainly hope for the best, and consider that we are justified in anticipating a fair improvement in business by next spring.

Pratt Chuck Co. (Drill Chucks), Clayville, N. Y., write us:

We have on the whole to report a satisfactory year's business.

Our sales show a large increase over last year, both from our domestic and foreign trade, and have employed without interruption our full complement of men.

During the year we have built and equipped a plant for the manufacture of cold drawn steel and brass ferrules, and are developing a very satisfactory business in this line. We are in hopes the new year will restore that measure of prosperity to the industries of the country that will warrant a larger demand for all classes of machinery. Allow us to say we consider our advertisement with you has aided us materially in our sales.

Pratt & Whitney Co. (Machinists' Tools, Forging and Finishing Machinery for Sewing Machine and Gun Manufacture, and Special Purposes), Hartford, Conn., write us:

The volume of business done by Pratt & Whitney Co. from January 1, 1893, to the end of December, 1894, is well represented by an hour glass, the shipments gradually decreasing during the former and increasing during the latter year. The difference in the aggregate of charges is less than 5 per cent., that for 1894 being less than for 1893, but as prices have fallen off from month to month, the amount of material handled during each year has probably differed but little. About 12 per cent. of the last year's shipments went abroad. The number of employes increased from 730 to 770. The improvements in the construction of machines and in processes of manufacture have not had less attention than in former years, and the number of new designs has been fully up to the average. A liberal number of unfinished orders will be carried over into the new year.

Q and C Company (Railway Specialties), Chicago, Ill., write us:

We only entered into the machinery business in a general way last July, introducing then the Q & C shop saw. We must say we find, in spite of the many reports of hard times, that we have had no fault to find whatever, the sales being far beyond our expectations and the prospects for the new year certainly very bright.

A. D. Quint (Turret Drills), Hartford, Conn., writes us:

My experience with the turret drills shows that the business of 1894 was about 70 per cent. of that of 1892, and practically the same in proportion as the last six months of 1893.

There has been a small reduction in cost of labor and material and a larger one in price of product. The large No. 2 pattern drill, with from 2 to 12 spindles brought out last spring, has been well received by the trade, and sales have been fair, considering the times. With an improvement in business I anticipate a large demand for them.

I will not hazard a guess as to business for 1895, and can only say I hope it will be better than for the past 19 months.

Sebastian Lathe Co. (Engine and Speed Lathes, Machinists' Tools and Supplies), Cincinnati, Ohio, write us:

We have, in common with all manufacturers, suffered from the depression, but we are glad to note that the effects are now apparently passing away, and we look forward to a gradual improvement.

The year 1894 opened with but slight improvement, if any, over the previous months. We had a fair share of inquiries, but seemed to be unable to close with many of them—there seemed to be a disposition to wait. During the year we had a number of "spurts," when we were quite busy, but business was unreliable. The year is winding up fairly well, and we confidently believe that from this time on business will continue to improve gradually, until we reach the "good old times" again.

Labor has been lowered, but with the improvement of business there is a demand for the restoration of former wages.

Some of the material used by us is lower than a year ago. Prices have to some extent been demoralized, but are now stiffening up, although it will be some time before we can expect to get as good prices as before the depression set in.

We expect no boom, but simply a gradual improvement, for two or three years to come. As it will take some time to reach the present capacity of our works, we contemplate no enlargements.

Sittmann & Pitt (Machinists, Manufacturers of Special Machinery and Novelties, Model and Experimental Work), Brooklyn, N. Y., write us:

As to the condition of business, we have found a marked improvement in this year. During the summer months business fell off somewhat, but the fall of the year brought us more business than the spring, and we find things steadily improving, with good prospects for 1895.

We have added but few tools this year, but contemplate increasing our facilities early in 1895.

Price of labor and material we have found about the same, but product has been reduced, owing to improved methods of production.

Skinner Chuck Co. (Independent, Universal and Combination Lathe Chucks, Planer Chucks, Drill Chucks, Face Plate Jaws, etc.), New Britain, Conn., write us:

During the past year we have added some new varieties of tools to our list and have correspondingly increased our facilities for manufacture.

We note a slight improvement in the machine trade generally, which is shown by a considerable increase in our business during the last four months. Our payments for labor for that time have been fifty per cent. more than for the corresponding time in 1893. There has been as yet very slight change in the cost of material.

E. G. Smith (Measuring Instruments, Fine Mechanical Tools for All Trade and Scientific Purposes), Columbia, Pa., writes us:

Although the first three months for 1894 were very encouraging, there was very little done during the summer months; it seemed as if everybody wanted to get along the best way he could.

However, for the last two or three months there is again quite a demand for my tools, which, I suppose, is due to more men being again at work. Quite a number of "manual training schools," colleges, etc., have equipped their mechanical departments and physical laboratories with my instruments. The outlook for 1895 is very encouraging, as frequent inquiries for my tools are coming in from all parts of the United States, and my sales are just double during the last three months what they were for the same period in 1893.

Springfield Machine Tool Co. (Brass and Ironworking Machinery and Iron Founders), Springfield, Ohio, write us:

The first quarter of 1894, owing to the radical change we made in our business, from manufacturing exclusively for certain jobbers to enlarging our lines, and seeking other channels of trade, we did practically nothing. Since then we have enjoyed an ever increasing and satisfactory trade. Our new venture, that of making and introducing our new "Springfield-Muller" engine lathe, has occupied our attention for the past six months, in which time we added largely to our equipment and facilities, and now have every reason to feel assured of a busy year coming. The past three months were particularly very satisfactory, especially our trade on crank shapers and power presses. Our export trade is also assuming some proportion.

The prices for skilled labor have been scarcely changed in the past year, but iron and steel have been materially reduced in price. But none of the items mentioned are in proportion to the reduced prices of machine tools. This we trust will not be a cause of complaint one year from now. In our job foundry department we note little difference in the output, it having remained very steady throughout the year, but the prices obtainable are constantly of a downward tendency.

Taking it all in all, we are thankful it is no worse, and believe that trade will surely and slowly, however, get better.

Other letters stand over, to be published next week.

MANUFACTURES

The Auburn Motor Company, Auburn, Me., have a crew working nights. The large number of orders makes this necessary.

The Long Island Railroad Co. have placed a contract for their new pier shed with The Berlin Iron Bridge Co., of East Berlin, Conn.

The Berlin Iron Bridge Co., of East Berlin, Conn., are building a new highway bridge for the Boston & Maine Railroad, at Somerville, Mass.

A new company is to be formed by the manufacturers of the Humber and Raleigh wheels under Massachusetts laws, to make those wheels in Westboro, Mass.

C. G. Thayer, formerly superintendent of the association grounds and Grand Hotel at Point Chautauqua, has opened a machine and general repair shop in the Amidon block on East Second street, Jamestown, N. Y.

The Livingston Manufacturing Company, of Rockland, Maine, have bought a lot of land on Lime street in that city, 70x72 feet, and will at once erect a new plant for their business, removing from their present quarters on South Main street.

It is announced that one set of the shops of the Michigan Peninsular Car Company will start up January 1st probably, or before February 1st, at the latest. The shops will be run to their average capacity, but it is yet uncertain whether they can be kept running all through next year.

In addition to an increase in their pay and work, employes of the Warren Foundry, Phillipsburg, N. J., were pleased recently to learn that a $37,000 contract for iron pipes had been received by the company. The contract is for eight miles of 10-inch main, and six miles of distributing pipes for the Newton water-works.

A new corporation known as the Gates Vapor Engine Company started its new works in the Chase Mantel Company's building, Kalamazoo, Mich. They will build the Spaulding gas and vapor engine. Their present quarters are only temporary, as next spring a new modern factory will be built for their accommodation.

The Jamestown, N. Y., branch of the American Axe and Tool Co., is closing up business after a year of fairly good trade. An average of 150 men have been employed during the year, a force as large as ever found work at this plant. The management is preparing for a week's shut down between the holidays.

The Belleville (Ill.) steel works will shortly be removed to Alexandria, Ind. The works furnish employment to about 600 men. The reason given for the removal of the works is that the town of Alexandria has agreed to give the company thirty acres of land, furnish it with an artesian well and connect the plant with the natural gas wells of Indiana.

The organization has practically been completed whereby a company of Manchester (N. H.) men propose to operate one of the mica mines of New Hampshire. The corporation is called the Orange Mica Mining Co., and officers have been elected as follows: President, C. C. Hayes; treasurer, W. G. Africa, and others. The authorized capital of the corporation is $250,000, a substantial amount of which has been already taken. A mine has been purchased in the town of Orange, N. H. Hon. F. M. Rollins has been chosen business manager, and operations will be begun at an early date.

The old stone factory and buildings connected therewith, situated at the corner of Division and North Vine streets, Waterbury, Conn., have been leased to Ira L. Hawkins, of that city, for the purpose of manufacturing machinery and tacks. Business will commence about January 1st. Mr. Hawkins has been engaged for a number of years in the manufacture of machinery at the City Mills, and has recently purchased from a company at Springfield, Mass., its machinery and equipment for tack making. About forty hands will be employed, and a new building will be erected to accommodate additional machinery.

A big deal was consummated at Toledo, Ohio, recently, involving from $6,000,000 to $8,000,000, which will make Toledo the most important oil center in the Ohio field, and give the Standard Oil Company a new and formidable competitor. It is a combination of three independent companies, with chances in favor of two more going into it. The Sun Oil Company, of Toledo, has the largest production of petroleum in Ohio, except the Standard. The next member of the combine in importance is the Merriam & Morgan Paraffine Company, of Cleveland, and the third is the Crystal Oil Company, of Toledo. The two others which will probably enter are the Paragon Refining Company, and the Craig Oil Company, both of Toledo. The name of the new concern is the Diamond Oil Company. It will manufacture all products from the crude to candles.

The Tradesman, Chattanooga, Tenn., in its report on the industrial condition of the South for the week ending December 24th, reports continued improvement in the development of the cotton manufacturing industry in the Southern States, as is shown by the organization during the week of a $75,000 corporation to build a mill at Walhalla, S. C., with others reported at Atlanta and Eatonton, Ga., Charlotte and Shelby, N. C., and Bath, S. C. The lumber business is increasing its output, with more firmness in prices. The Hilton Lumber Company has been organized at Wilmington, N. C., capital, $80,000, and the R. L. Trigg Lumber Company, with $25,000 capital, at Little Rock, Ark. Iron is steady, with diminished stocks on hand and increasing production. Coal is unchanged, both as to output, which is large, and as to prices. Thirty-six new industries were established or incorporated during the week, among which are: The Interstate Iron Works, capital, $250,000, of Meridian, Miss.; a $200,000 cotton compress at Augusta, Ga., and two at Waco, Tex.; the Crystal Ice and Cold Storage Company, of Clarksburg, W. Va., capitalized at $100,000, and the Snolta Valley Land and Colonization Company, of Galveston, Tex.; capital, $65,000. *The Tradesman* also reports an ice factory at Murfreesboro, Tenn., car coupler works at Knoxville, Tenn., electric lighting plants at Mammoth Springs, Ark., Natchez, Miss., and Paris, Tenn., and flour and grist-mills at Vertrus, Ky., Wilson, La., Aspen Grove, N. C. and Gath, Tenn. An ice factory is to be built at Statesboro, Ga., an iron furnace at Pulaski City, Va., a coal mine is to be opened near Fairmont, W. Va., and woodworking plants at Fayetteville, Ark., Orlando and Grove City, Fla., Fristoe, Ky., Washington, N. C., Vicksburg, Miss., La Fayette, Tenn., and Norfolk, Va. Water-works are reported at Prescott, Ark., Thomasville Ga., McKinney, Tex., and Bramwell, W. Va.

Machinists' Supplies and Iron.

NEW YORK, December 29, 1894.

Iron—American Pig—We quote standard brands, $12 to $12.50 for No. 1; $11 to $12 for No. 2, and $10.50 to $11 for No 2 Plain. Southern brands, $11.25 to $11.50 for No. 1; $10.25 to $11 for No. 2; $10 to $10.50 for No. 3; $10.50 to $10.75 for No. 1 soft; $10.25 to $10.75 for No. 2 soft; and Foundry No. 4, $9.50 to $10.

Antimony—Prices have a lower tendency; jobbing business is fair. We quote L. X., 8c. to 8¼c.; Cookson's, 8¾c. to 8¾c.; Hallett's, 7¼c. to 7¼c.; and U. S. French Star, 9¼c. to 9½c.

Lard Oil—Prime City we quote at 55c. to 56c.

Copper—Business is not as good as it was last week; however, the demand is fair. The producers keep prices firm. Lake Copper is quoted at 10c., and Casting Copper is held at 9¾c. to 9½c.

Lead—The market is quiet. It is said that good-sized lots have been sold at 3.05c., but producers ask 3.10c. for early shipments.

Spelter—There is no change in the market; the prevailing prices at the present time are 3.25c. to 3.30c; nothing less than 3.25c. is accepted for the higher brands.

Tin—The market is dull, largely due to the holiday season. Consumers buy moderately, and deliveries on contract are fair. For round lots 13.75c. to 13.80c. net cash is asked.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

A practical machinist & designer wants pos. selling & erecting machinery. BOX 63, AM. MACHINIST.

Position wanted by a first-class planer hand, quick and accurate; best of refs. BOX 86, AM. MACHINIST.

Wanted situation as foreman or assistant by machinist of 18 years' experience; last 4 as foreman. BOX 79, AMERICAN MACHINIST.

Wanted—An experienced traveling man to sell duplex steam pumps; give experience and salary required. Gardner Governor Co., Quincy, Ill.

Wanted—Sit. as foundry foreman; experienced 11 years on all kinds of heavy and light work. Strictly temperate, American; age, 38. BOX 81, AM MACH.

Draftsman and designer, A1 mechanic, with 10 years' experience, steam engine, printing presses, etc., would like position. BOX 85, AM. MACHINIST.

Experienced traveling salesman wants position to represent on road or otherwise manufacturers of pumps, boilers, engines, or any mechanical line. A1 references. Address BOX 83, AM. MACHINIST.

[*Continued on Page* 13]

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For reducing and maintaining an even steam, air or water pressure. These valves have been on the market for years, and are used by all the best and largest steam plants of the world.

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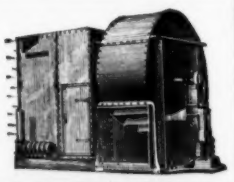

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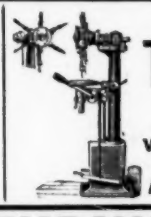

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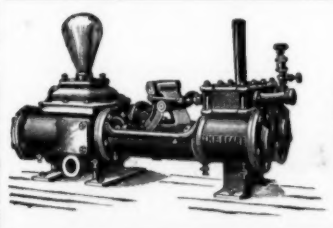

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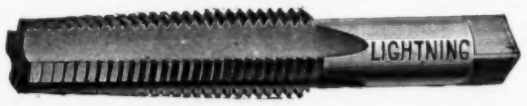

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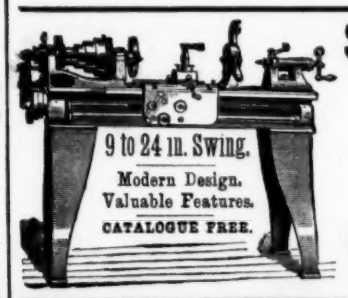

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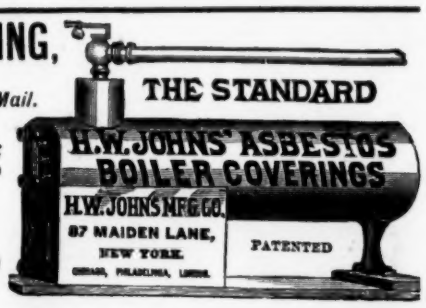

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10	1 1-2	.95
11	1 3-4	1.10
12	2	1.30
13	2 1-4	1.35
14	2 1-2	1.45
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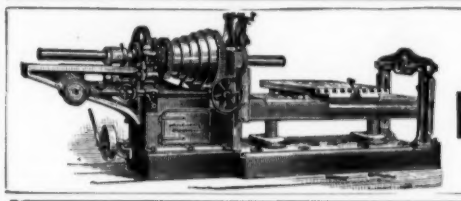

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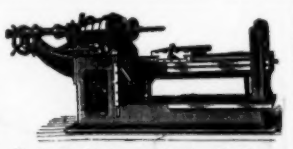

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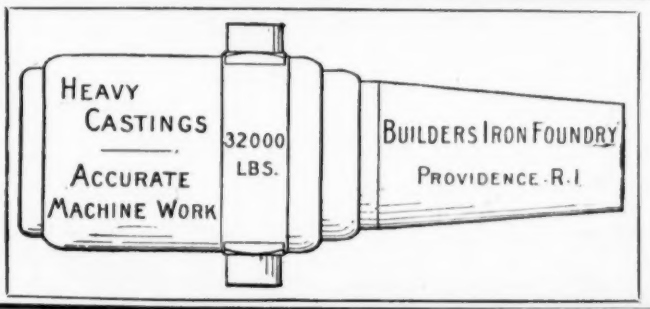

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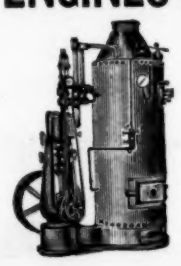

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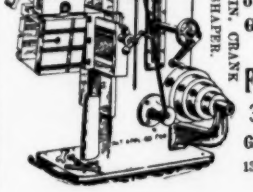

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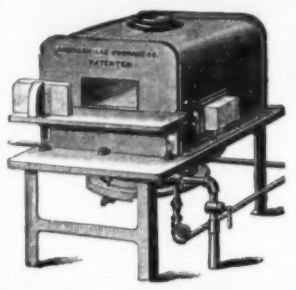

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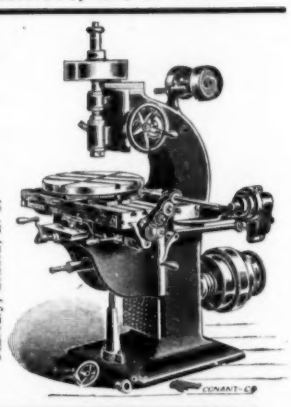

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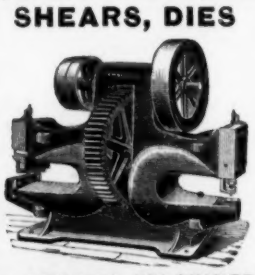

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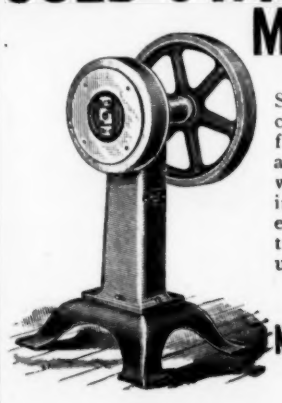

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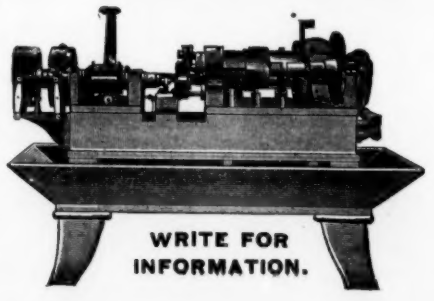

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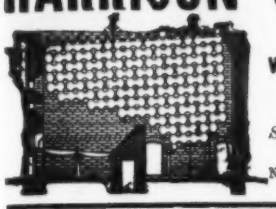

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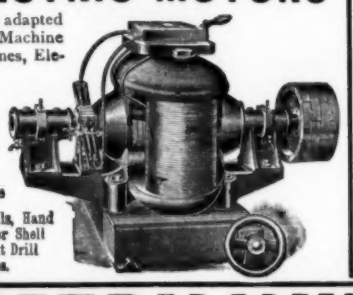

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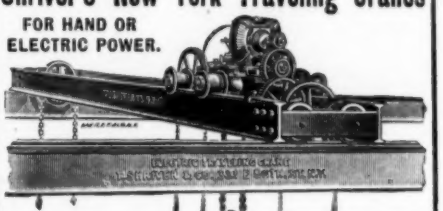

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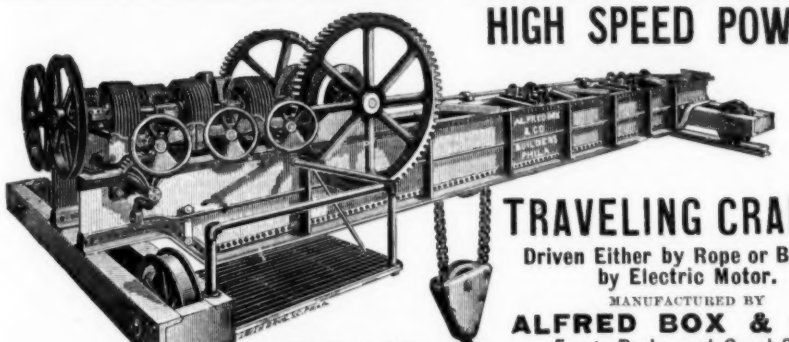

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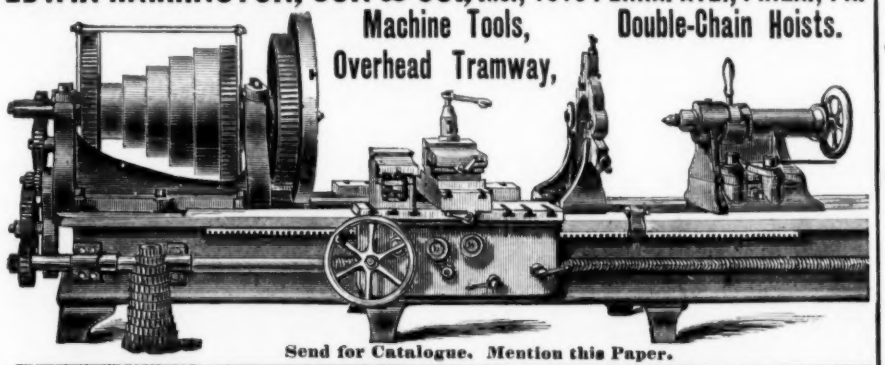

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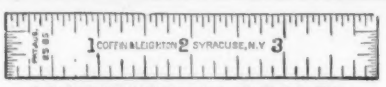

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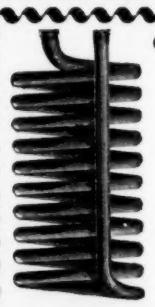

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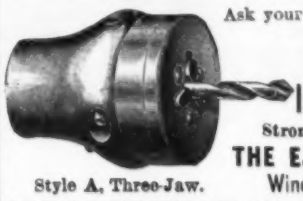

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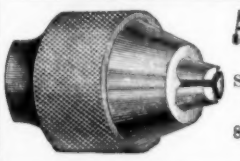

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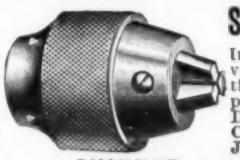

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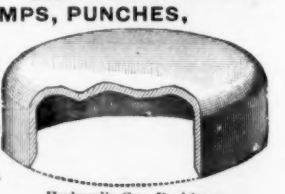

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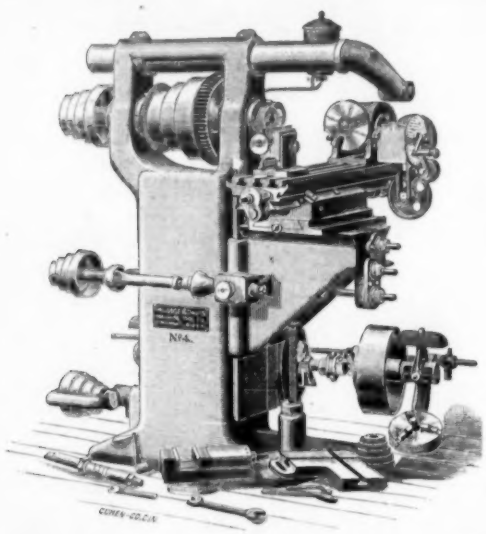

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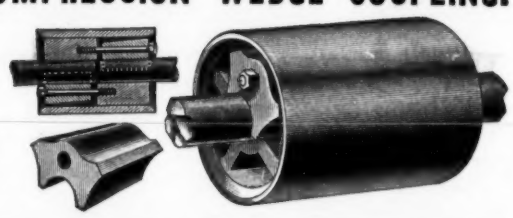

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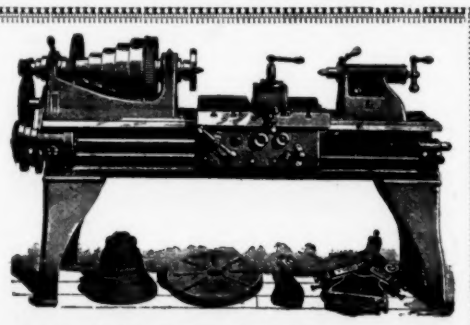

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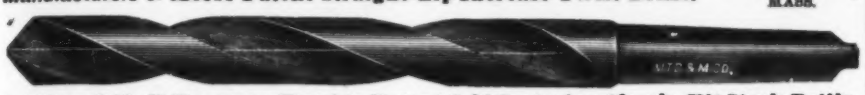

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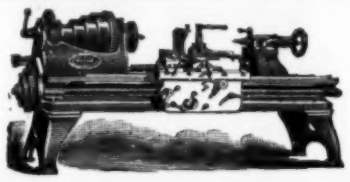

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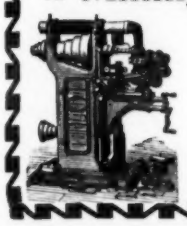

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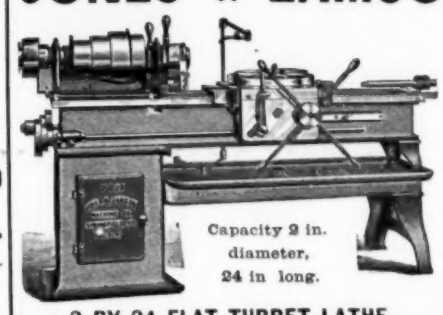

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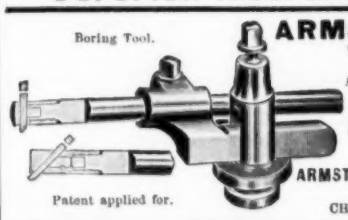

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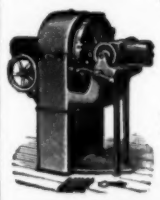

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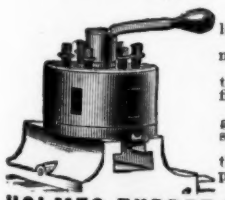

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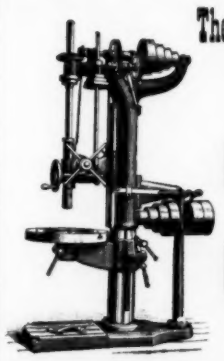

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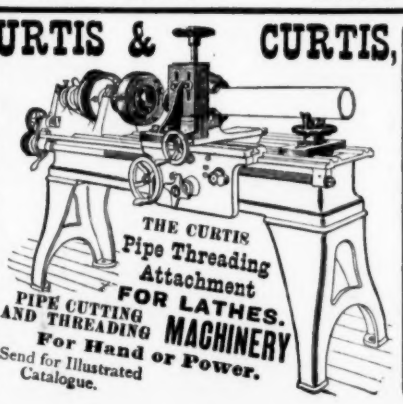

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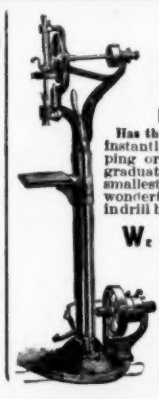

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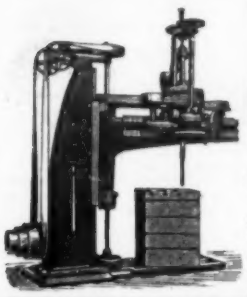

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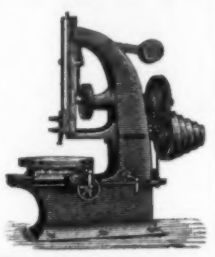

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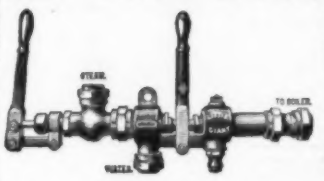

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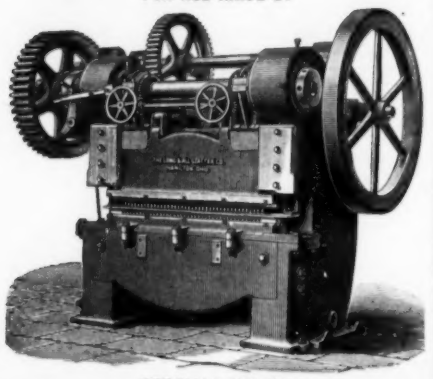

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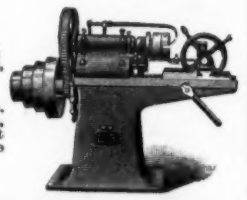

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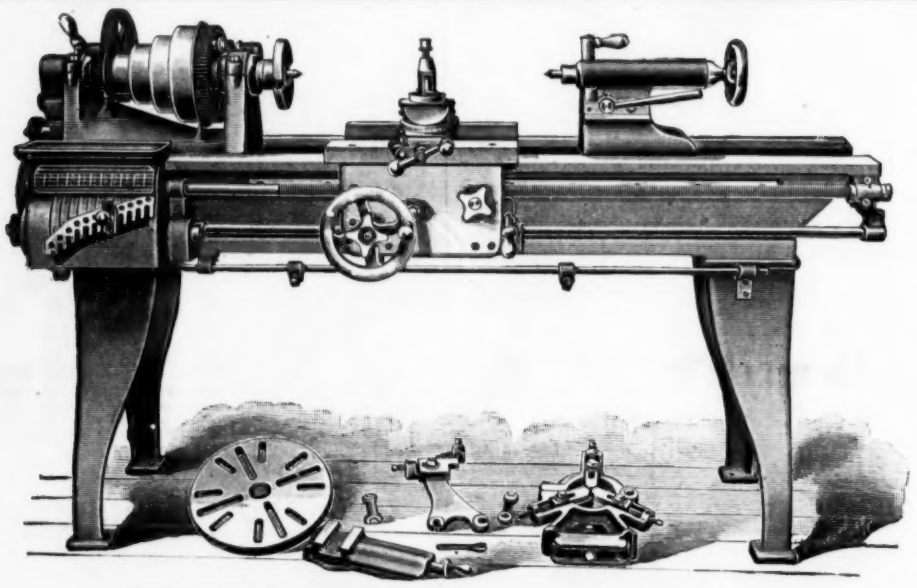

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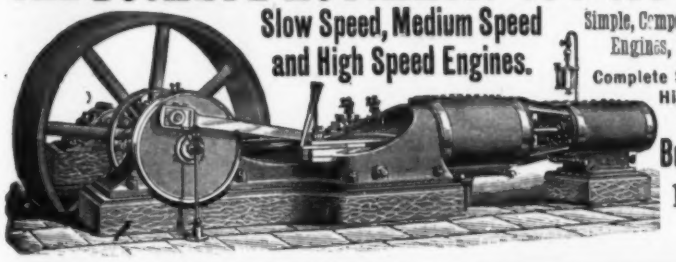

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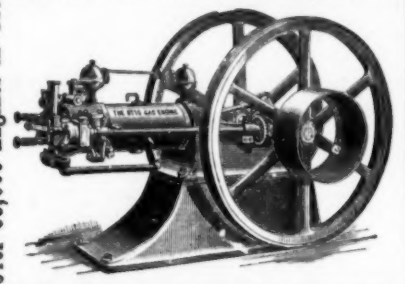

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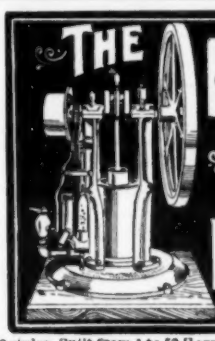

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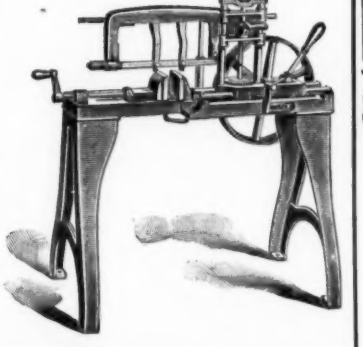

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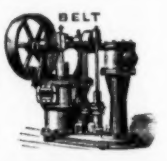

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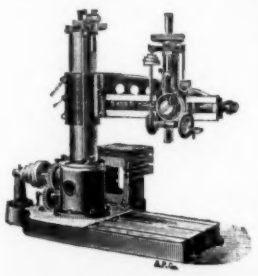

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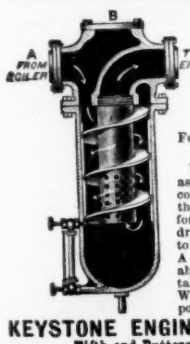

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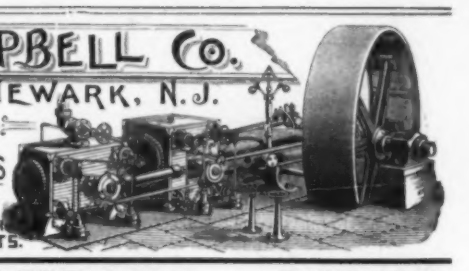

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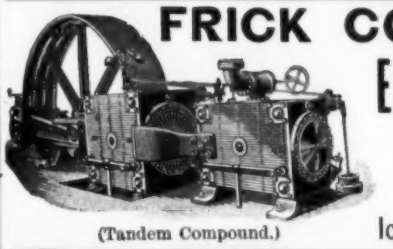

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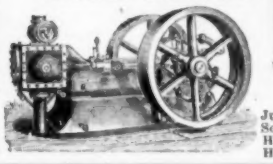

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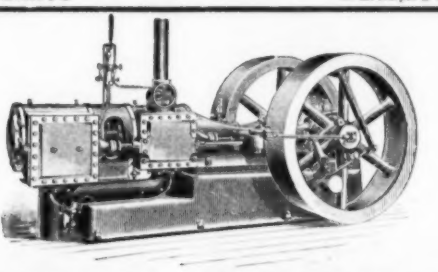

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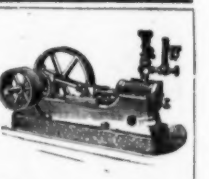

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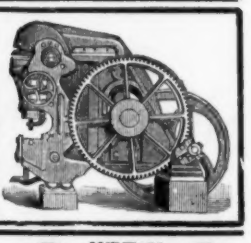

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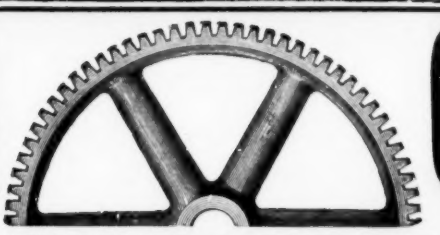

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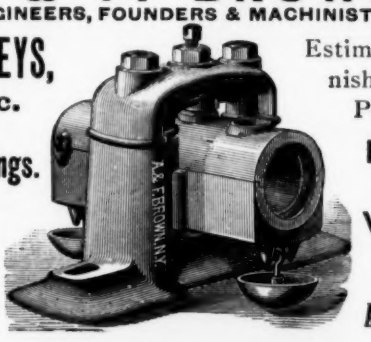

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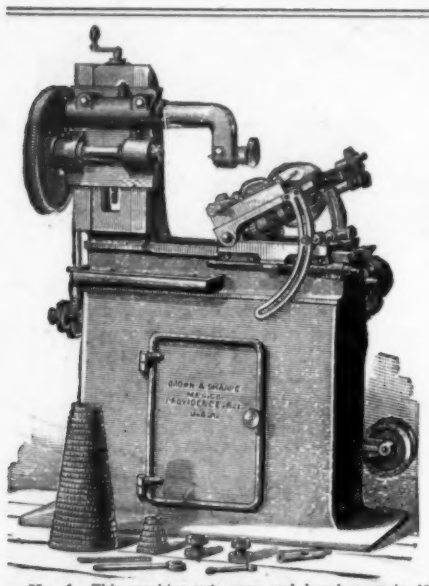

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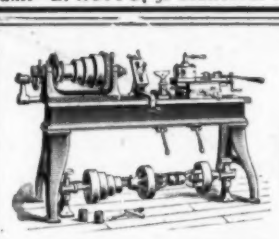

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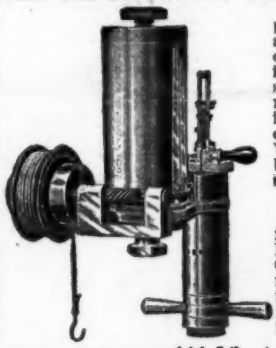

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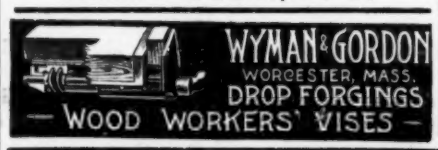

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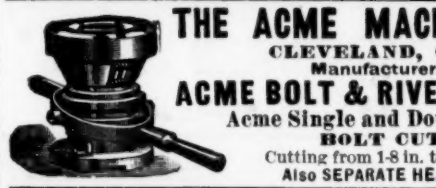

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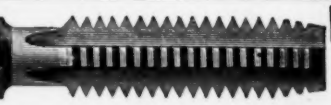

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